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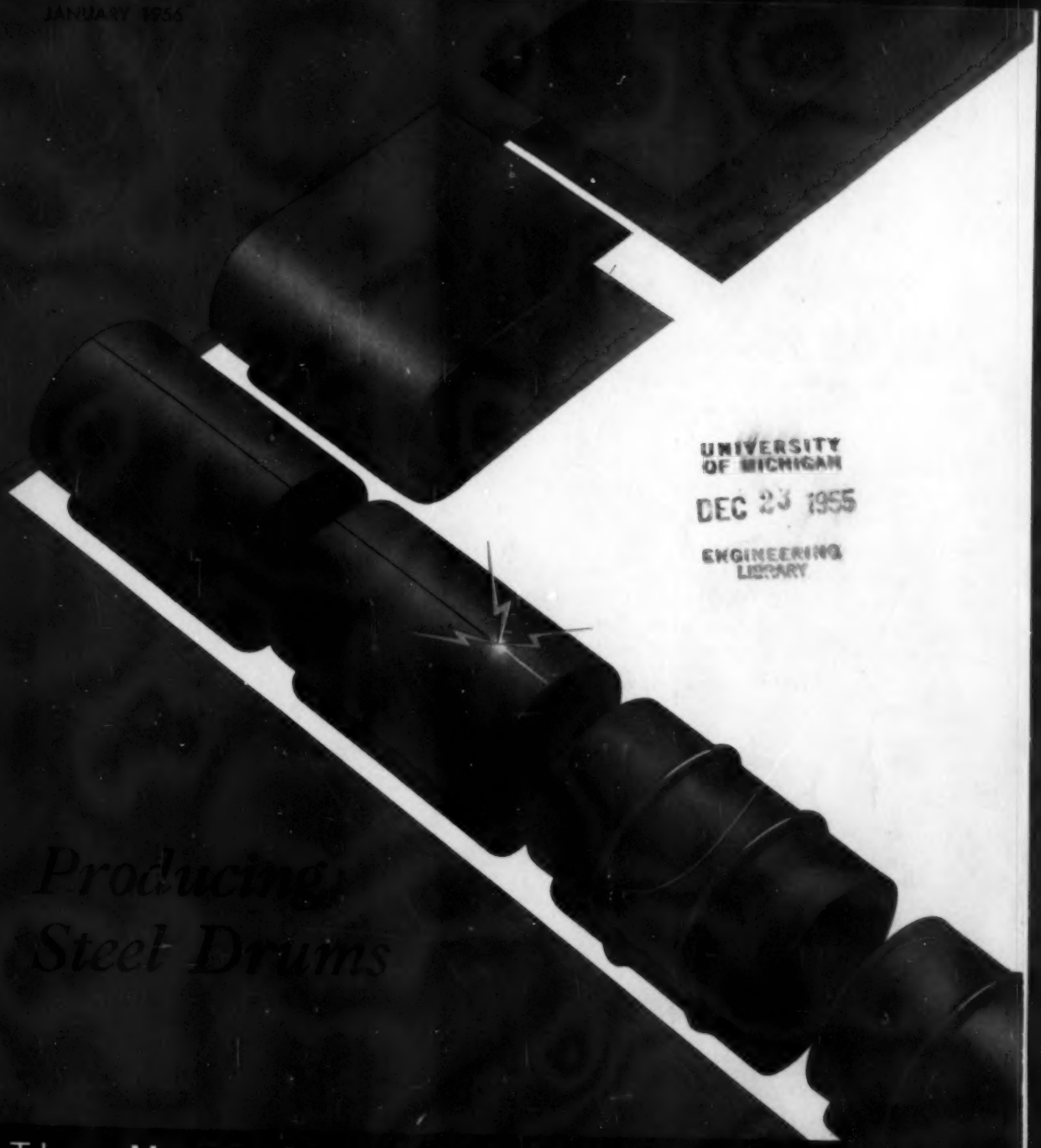

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AUTOMATION

Producing Steel Drums

The Magazine of Automatic Operations

- Sizing Metal Powders
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A PENTON PUBLICATION

WEAN "AUTOMATED" TRANS-CAR LINE SOLVES HEAVY PARTS HANDLING PROBLEM

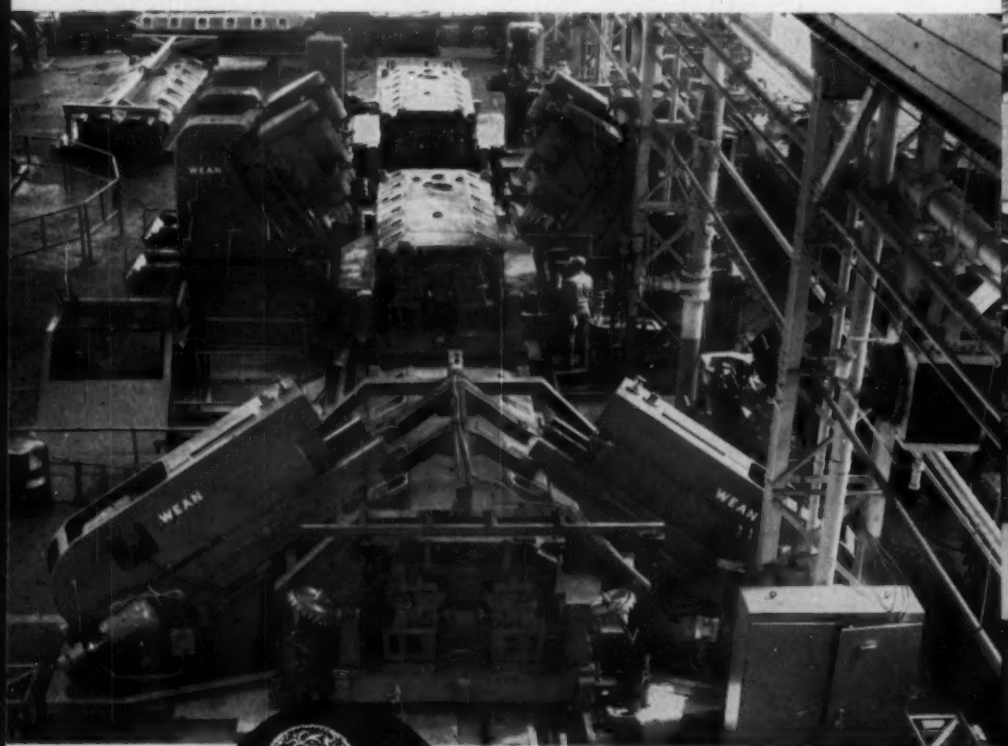
Unique system carries bulky sections through entire machining operation

The Massey-Harris Co. is used to handling and precision working large machine components. Thus, when they accepted the contract to produce combat vehicle hulls for the Army they immediately got in touch with Wean Equipment engineers.

A team of Wean Equipment engineers working with a similar group from Massey-Harris soon vetoed the possibility of using standard machine tools on a cost basis. It was decided a complete line, especially built to do the job, was the only practical answer.

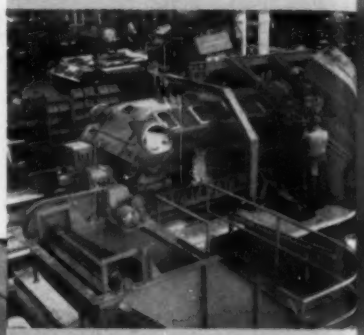
In eight months' time, Wean Equipment developed and built the now famous trans-car line. The line is composed of three stations: milling, drilling, and boring. The unusual feature is the car that operates on a set of tracks, running between stations, and eliminates all handling of the bulky, heavy hull.

If special "automated" machinery is what you're looking for, call in a Wean Equipment man today. He represents probably the widest experience in specialized machinery to be found anywhere. Like Massey-Harris, you'll find Wean the surest, most inexpensive way to soundly engineered, result-getting machinery.

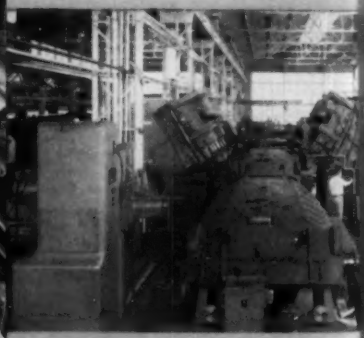


Over-all view of Wean Line that effected tremendous savings in producing giant hulls.

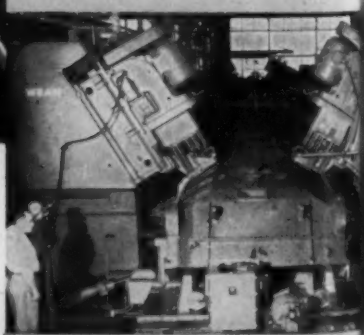
Unique trans-car that carries h station to station.



Milling operation. Dry cuttin carbide cutters. Air jets remov



Drilling operation. Beneath the coolant system with magneti separator.



Boring operation. Drills, tap reamers are of high speed ste operations are automatic.

Wean

EQUIPMENT CORPORATION

CLEVELAND, OHIO

JANUARY, 1956
Vol. 3—No. 1

AUTOMATION

THE MAGAZINE OF AUTOMATIC OPERATIONS

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automation outlook

APPLIED TO AUTOMATION

". . . through the consolidation of these companies, their respective abilities in engineering, manufacturing and marketing would be combined and applied to problems of automation in commerce and industry and to the complex requirements of national defense . . ."—*Directors of Sperry Rand Corp.*

FORCED NEW IDEAS

". . . processing of coiled material has retained its basic function; namely, the automatic production of shaped or rectangular blanks from strip steel. It is certain that subsequent problems of fabrication in automatic or semiautomatic lines have forced the application of many of these new ideas into the latest equipment designs . . ."—*Joseph F. Lyden, McKay Machine Co.* *See Page 34.*

SMALL COMPANY BENEFITS

". . . my guess is that we will be astonished to look back ten years from now and see how much automation has resulted from offering in the market place standardized automation equipment, developed to meet the common denominator requirements of hundreds of thousands of small and medium-size companies. I am not saying that automation equipment will be in the class of the shelf item, but I am sure that this logical interest in the broad rather than the narrow market will ease the load on many a small company which wants to benefit from a certain amount of automation but cannot afford the cost of designing and tailor-making all the necessary equipment. . ."—*Paul B. Wishart, president, Minneapolis-Honeywell Regulator Co.*

BASIC ECONOMICS

". . . the ultimate form of automation could be described as a very large black box into which raw materials and data flow automatically for processing and distribution. This is still a theoretical concept, primarily for economic reasons. No manufacturer will introduce completely automatic methods if total cost per unit of work exceeds that of manual methods and mechanization. There is in addition the problem of writing off the cost of a completely automatic factory during the period of acceptability of its products . . ."—*Elmer W. Engstrom, executive vice president, Radio Corp. of America.*

CHANGE FOR THE BETTER

". . . it is not desirable to seek to maintain a status quo in employment in any particular industry or segment of the economy. Flexibility is essential. The progress of the past could never have been achieved if millions of Americans had not shifted from farming and mining to manufacturing, trade and service occupations. Millions who might have been farmers or miners have better jobs in other occupations. Those remaining have larger incomes because each now produces more, thanks to technology. Occupational shifts are necessary and desirable, both for the individual, who is almost invariably upgraded to a better job, and for society, which measures its standard of living by the availability of goods and services beyond the basic essentials of living . . ."—*Council for Technological Advancement.*

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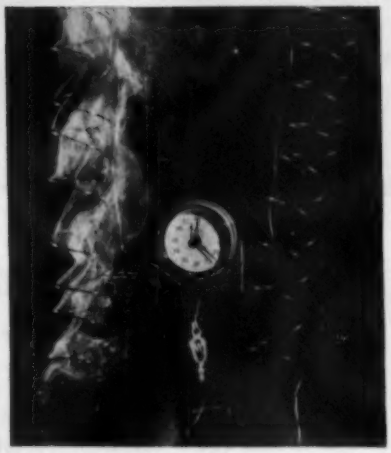
BPA

Roomy wiring compartment. Also available with open wiring in ratings 25–250 va.
Wiring diagram printed on cover of wiring compartment. Numbered leads make wiring easy.



Comparative tests between standard enameled wire and G.E.'s new Alkanex enamel wire prove that Alkanex affords maximum protection against burnouts. With both wires short-circuited, the standard enamel smoked in 25 seconds and completely disintegrated in 45 seconds, while the Alkanex had hardly begun to smoke.

CONTROL TRANSFORMER LINE

SPECIFY FROM G.E.'s COMPLETE LINE OF DRY-TYPE TRANSFORMERS

TYPE M TRANSFORMERS for indoor or outdoor general-purpose light and power service. Available in ratings through 15 kva.

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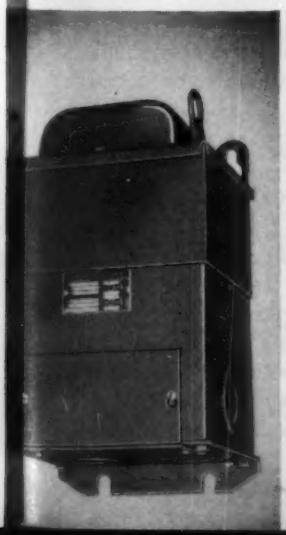

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Write today for your copy of this new 32-page bulletin that provides all application and buying data for G.E.'s new line of control transformers, autotransformers, machine tool transformers and other dry-type transformers for special applications.

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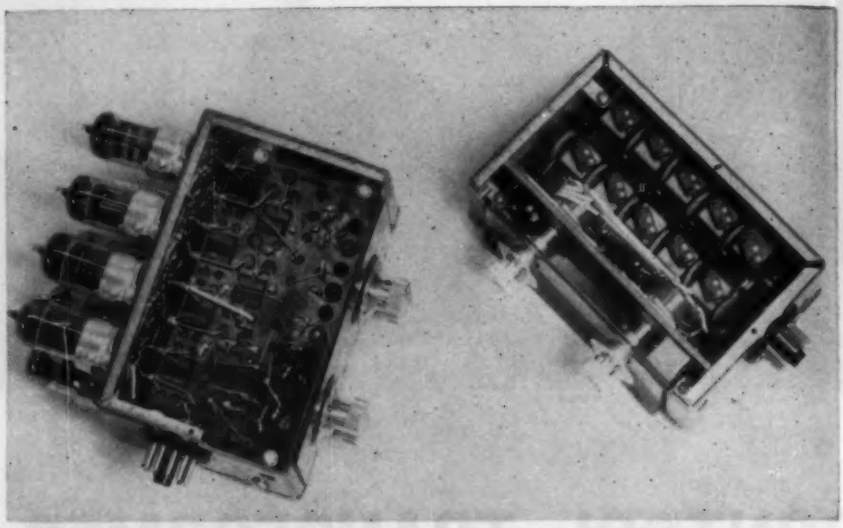
AUTOMATION news

Today's events and developments in the field of automation

Reliable Counter-Controller Uses Magnetic Amplifier

UNRELIABILITY of vacuum tube circuits continues to spark research and development of suitable replacement items—with one of the latest being reported by the Berkeley Div. of Beckman Instruments Inc. The "ferristor", a magnetic amplifier, has been introduced in a counter-controller now in production at the Berkeley Division. The new magnetic amplifier element is capsulated in epoxy resin in a cube of ½-inch sides and is immune to shock, moisture, prolonged overloading or vibration.

The new dual preset controller containing the magnetic amplifier can handle up to 10,000 counts per second and produce an output signal at each of two presettable count totals. Input pulses may be obtained from photocells, magnetic pickups, electrical contacts, etc. The output signal, through a built-in 5-ampere relay, operates solenoids, power relays or other control devices. The first output signal may be used to slow down operations preparatory to stopping at the second preset count total.

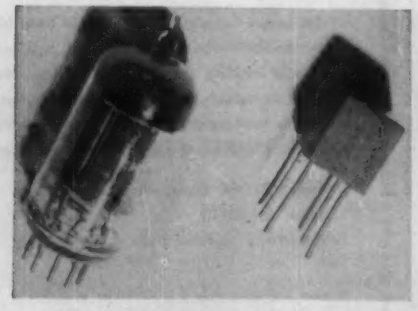


DECIMAL counting unit equipped with ferristors compared to older model built around vacuum tube circuits. Older electronic counter-controller utilizing this unit required 54 tubes; new ferristorized model contains only two. For ultimate in reliability, pushbutton activated marginal test permits constant surveillance of condition of the tubes which are used to allow replacement prior to failure. The ferristor is a development of the Berkeley Div. of Beckman Instruments Inc.

Industrial applications include control of high-speed counting, weighing, sorting, packaging, shearing equipment; cut-off of motors, turbines, piston or jet engines at precise predetermined revolution counts or rpm; computer timing, sequence control, etc.

A second new instrument containing the magnetic amplifier is an EPUT meter for measuring events occurring during a precise 0.1, 1 or 10-second interval, displaying the results in direct-reading digital form. Operating from any suitable transducer, it gages pressure, temperature, flow, velocity, viscosity, frequency, rpm or counts events or objects at rates up to 40,000 counts per second.

The advantages of equipment including a ferristor in place of a vacuum tube include not only increased reliability but overall longer component life because circuits operate at extremely low current and voltage levels and simplified installation, servicing and operation. The only vacuum tubes in the new controller and meter are contained in an RF oscillator which supplies power to the ferristor. Continuing development is expected to eliminate even these tubes.



CAPSULATED magnetic amplifier compared in size to miniature vacuum tube. New element can perform most functions of vacuum tube with an additional important feature of an expected service life of 5 years.

Aid Small Plant Automation

SPECIALIZING in the design and development of small custom-built automation systems, the Clegg Laboratories Inc. are expanding their facilities. The expansion will provide engineering, model shop and production facilities for spe-

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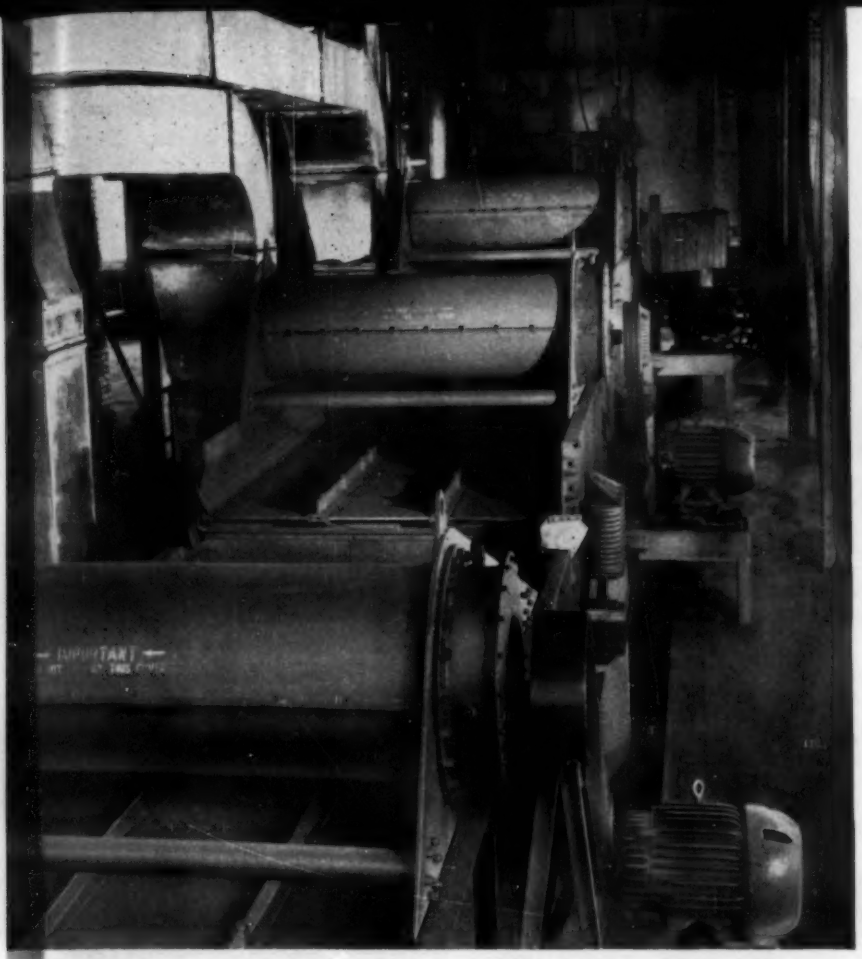


HOW LYNCHBURG FOUNDRY USED PROFESSIONAL ENGINEERING TO SOLVE HIGH-VOLUME PRODUCTION PROBLEMS AT INDUSTRY'S NEWEST, MOST MODERN SHELL MOLDING PLANT

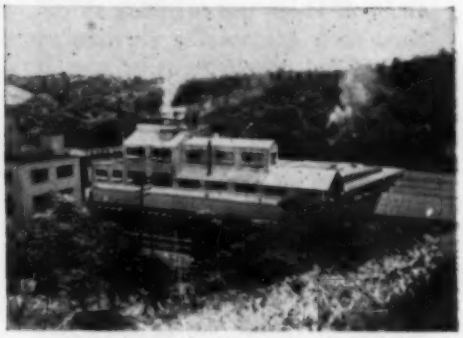
NEW FACILITIES ENGINEERED BY GIFFELS & VALLET PRODUCE 100 TONS OF FINISHED CASTINGS IN 24 HOURS!

The Lynchburg Foundry Company's new shell molding plant was built to produce large quantities of close tolerance, fine finish castings. Although shell molding is highly adaptable to mechanized operations and offers many other advantages, the planning and engineering for an installation of this size posed many new problems.

Sand is discharged from hopper bottom railroad cars, aerated, and delivered to storage silos pneumatically.

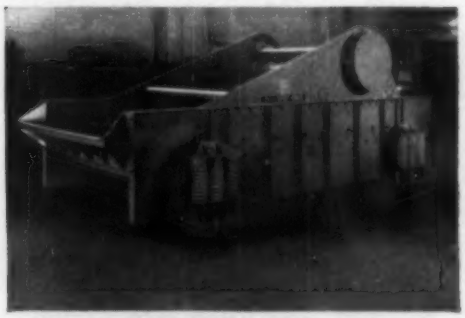
As the project progressed, the extensive facilities of both organizations were coordinated on all phases of design, engineering, equipment specification and construction. In many instances, G & V's background of experience in other industries proved of great value. Two specific examples of this were the methods used to handle the extremely fine molding sand, and the large quantities of iron shot used for shell backup.

The major sand handling problems were to control dust, prevent segregation, and introduce complete mechanization. 100 tons of dry sand with an average AFS fineness of 120 are used per 24-hour day. The sand is removed from box cars into storage silos, batched, and transported to the mullers by a completely enclosed pneumatic handling system. A specially designed cone, orifice and air slide at the base of each storage silo reverses the segregating effect of the sand entering the silo. Batches for the mullers are accurately measured by a unique electronic weighing instrument. This new sand handling system keeps dust and segregation at a minimum, and is similar to the modern mechanized methods employed in the bulk handling of cement, flour, and other dry materials.



Completed plant, looking toward the cupolas.

About 125 tons per hour of shot must be separated from the castings, then cooled and cleansed of sand. This is accomplished by a series of vibrating screens constructed of heavy-duty stainless steel cloth. Air exhausted through the screen at the rate of 150 CFM per square ft. cools the shot from above 300° to below 150°. The screen is designed so that air pull is equal at every point on its surface. Rate of travel and depth of the shot bed can be readily adjusted to meet varying requirements. All transfer points in the system are provided with a "stone box" so that the highly abrasive shot falls upon other shot, rather than abrading the chutes themselves. This method was adapted from similar applications in the cement and rock products industry.



Heavy duty vibrating screens air cool and clean the shot without the use of water.

These are but several examples of the many ways in which Giffels & Vallet's comprehensive planning-engineering services have pointed the way to greater output, lower costs and improved casting quality for the foundry industry. These services are discussed in a special Foundry Brochure. A copy will be mailed on request.

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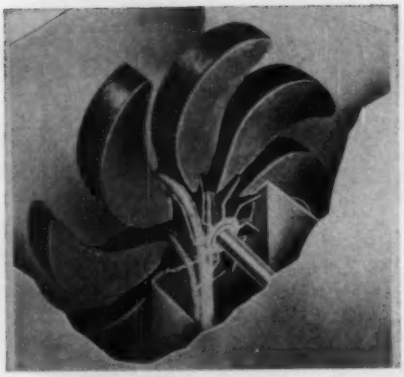
cial sensing and control equipment and will allow the company to expand their engineering services on design and development of special testing equipment.

The company specializes in custom-built test facilities and in the production of electronic scanning and control devices for many phases of automation in industrial machine operations. Among the installations they have engineered is one involving direct mail list plates which have been color coded. A scanner distinguishes between the colors and transmits the signals to an automatic control device which then electronically instructs an addressing machine to print or to by-pass each plate as it passes through the machine.

Another interesting system involves two tiny parts which are mechanically linked. Until an audio sensing and control unit was installed on a manufacturer's production line, determining which pieces were not properly matched up and joined was an involved and costly manual process. Now as the pieces drop from an automatic strainer-feeder the sound made by the falling part is picked up, passed on to a control unit and all incomplete parts are automatically routed off the production line.

RECENT appointments by Consolidated Electrodynamics Corp., formerly Consolidated Engineering Corp.: **Kennett W. Patrick,** formerly director of Systems Division is now director of Transducer Division. **Harry E. Burke, Jr.** succeeds Patrick as director of the Systems Division. **Kenneth Hines** has joined the Systems Division as a project chief. Hines, formerly a research physicist at Shell Oil Co., will specialize in petrochemical instrumentation.

Howard C. Jones is new director of manufacturing of the Consolidated Vacuum Division responsible for all manufacturing phases of the company's line of high vacuum equipment including pumps, gages and processing equipment for the



UNIFORM pH control for a water filtration plant is achieved with an automatic system involving recorder-controllers of the Bristol Co. and a dipper-wheel feeder produced by Omega Machine Co., Div. of B-I-F Industries Inc. Installation provides for feeding of alum to raw water, taking into account both the flow rate and pH condition of the water supply. A Bristol flow rate controller starts and stops the rotation of the dipper in proportion to the flow of the raw water. The speed of the dipper-wheel during actual rotation is varied by a pH recorder controller in proportion to the acidic condition of the water.

---

electronics, metals, distillation, and finishing industries. He will also direct traffic, purchasing, quality control, and plant engineering operations. For the past 8 years, Jones has been works manager of Delco Appliance Div. of General Motors Corp.

Tape Faults Examined With New Reading Head

READING head that makes possible the close examination of a short section of magnetic tape or wire is now being used at the National Bureau of Standards to locate and investigate faults in magnetic recording media. Developed by **J. R. Sorrells** of the NBS data processing systems laboratory, this instrument makes use of a reading head mounted on a rapidly rotating drum so that the head is in contact with the tape for a part of each revolution. Since the tape is held stationary, the head reads exactly the same set of signals once each revolution, and the playback can be displayed continuously on an oscilloscope and observed as long as desired.

In addition to providing a means for closely examining the playback signals from a specific portion of the tape, the reader can be used to scan through and edit a complete tape. The observer can easily locate any defective signals along the entire length of the recorded tape. Interchangeable parts provide a means for examining several different sizes of magnetic tape or wire.

In the design and development of magnetic tape and wire equipment for external pulse storage in electronic digital computer systems, one of the primary considerations has been reliability of operation. An important factor in magnetic storage is the condition of the tape surface itself. Errors in operation can be caused by any of several types of tape faults such as holes and raised spots in the magnetic surface, or creases in the tape. Very often the loss of several pulses or the gain of a single pulse may be caused by a flaw that is too small to be visible to the unaided eye. In investigating tape for faults it is desirable to read a small specific portion of the tape

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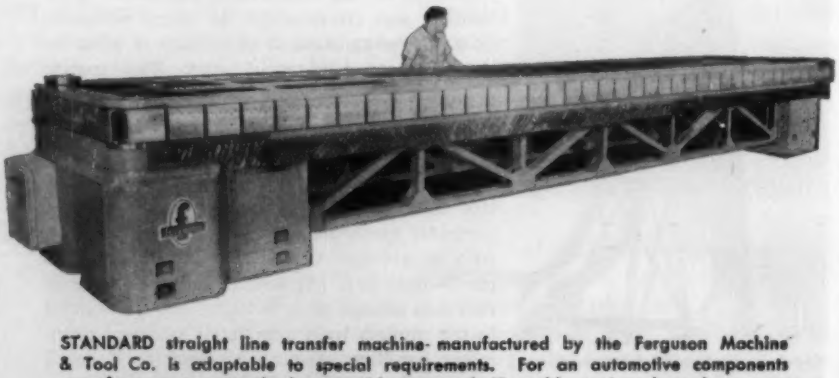
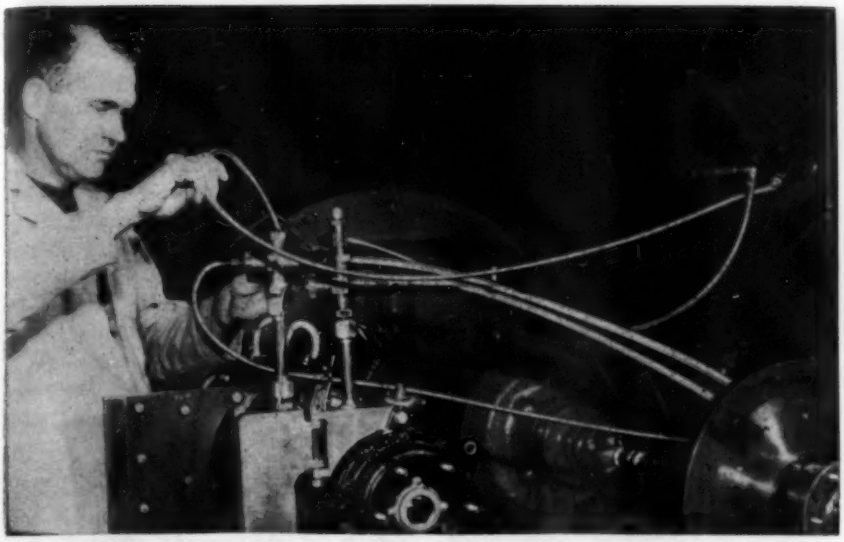


STANDARD straight line transfer machine manufactured by the Ferguson Machine & Tool Co. is adaptable to special requirements. For an automotive components manufacturer, two standard units with a normal 40 usable stations have been combined resulting in a machine with 88 usable stations. Automatic steering gear couplings will be assembled on the machine at a rate up to 3600 pieces per hour.



SPECIALLY designed hydraulic hose made of a fluorocarbon type resin instead of conventional rubber materials has solved a production testing problem for Sundstrand Machine Tool Co.'s Aviation Div. Problem involved short life of rubber hoses used in circulating hot oils and fuels. The hose, a product of the Resistoflex Corp., has extremely high corrosion resistance. It can withstand temperatures up to 450F and is wholly unaffected by all oils and fuels. It does not stiffen even after prolonged contact with fluids at 450F, and retains flexibility at temperatures down to minus 100F. The hose is supplied with a jacket of stainless steel armor braid and is rated at 1000 psi working pressure.

over and over again at a rapid rate, and to display on an oscilloscope a steady, clear picture of the playback signals. The rotating head reading device developed at NBS provides such a repetitive method for examining tape. Once faults are located, they can be removed or else avoided in the future, thus increasing the reliability of the tape.

Automation Goes To Sea

INCREASED shipboard use of automation is one practical means for improving the competitive position of the U. S. marine industry, according to **F. J. Newman** control expert of the Minneapolis-Honeywell Regulator Co. In a paper delivered before the Society of Naval Architects and Marine Engineers, Newman pointed out that automatic industrial instruments can help effect the same operating economies aboard ship that they do in industrial plants. The first step toward the ultimate in shipboard automation will be centralized engine room control with a variety of instruments feeding important measurements to a master panel from remotely located pumps, valves and fans. It was revealed that an experimental Navy destroyer had successfully demonstrated the feasibility of such remote operations. More than 3,000 flow meters, thermocouples and other sensing devices were installed to permit automatic combustion control, automatic ignition, and remote operation from the bridge. Newman also foresees the introduction of atomic energy and gas propulsion as two technological advances stimulating the use of automatic industrial instruments by the marine industry.

SYSTEMS development board has been established by Dashew Business Machines Inc. to aid purchasers of Dashew products in developments of systems and in procedures application. **Lee F. Kollie** has been appointed as vice-president in charge of systems development to preside over the newly created board.

Before joining the Dashew organization, Kollie was president of his own firm of systems and procedures consultants. He was associated with the Burroughs Corp. for many years and has also served as field sales manager for Visirecord Corp.

In making the announcement of the appointment, Stanley A. Dashew, president of Dashew Business Machines explained that it is expected that new efficiencies will be developed in control and identification procedures through integration of the new electronic Databosser with other office machines actuated by common language tapes and punched cards. The Databosser embosses fixed and variable data on metal identification plates at speeds up to 6500 per hour while simultaneously performing a series of other essential production operations.

Integrated Monitor Advances Process Industry Automation

LARGE industrial data reduction system for new Canadian refinery will be built by Fischer & Porter Co. The planned Automatic Logger—a $50,000 installation—will automatically monitor, analyze and record a total of 480 process variables for nine production units.

In terms of scope of operation, the complete elimination of routine checking by control personnel and the guarantee of accurate records even during the hectic times of refinery upsets, **Robert Stern,** vice president in charge of Fischer & Porter's data reduction and automation division, has termed the proposed refinery data reduction system a large step toward complete process industry automation.

The entire refinery will be operated from a single, central control room. This control room will house 126 feet of instrument panelboard containing hundreds of conventional meters and recorders which will indicate system performance at various points throughout the highly integrated refinery. The compact automatic logger, located in the control room, will have the task of continuously watching, in

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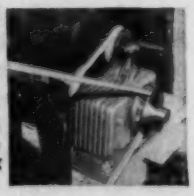
Lovejoy Variable Speed Pulleys

are available in a complete range of sizes from fractional to 15 hp., ratios to 3 to 1.

Shown is a typical Lovejoy countershaft unit controlling speed of automatic spring coiler.

Lovejoy Select-O-Speed Transmissions

can be supplied with hand wheel or lever control. Fractional to 5 hp., ratios to 10 to 1.



This Lovejoy Select-O-Speed is used to control the speed of a printing press.

For your variable speed application, there is a type and size Lovejoy unit that will give you initial economy, dependable performance and long service life.

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a sense, all 126 feet of panelboard, indicating trouble when it occurs and typing as well as punching in tape or cards a permanent record of refinery operation, normal and abnormal. Under normal conditions, the unit will automatically type out on a single log sheet the value of all variables each hour on the hour. Between logging intervals, the logger will continue to scan all variables, reporting only selected or abnormal conditions. In case of trouble, the logger signals an alarm and immediately types the out-of-line condition and its location. In addition to recording raw data, the logger will automatically compute and record more complex factors of interest to refinery operating personnel—such as total flow, efficiency ratios and yield factors. The automatic logger will also punch significant data directly into paper tape or cards to facilitate subsequent analysis by the accounting and engineering departments and speed preparation of summary reports to management.

FIVE color and sound movies have been prepared by the E. W. Bliss Co. and are available for showing to plant personnel. The movies include: "Power Press Maintenance," "Bliss' 1000th Transfer Feed Press," "Transfer Feed Presses in the Appliance Industry," "Bliss' Strip Feed Press, and The Bliss-Crary Tonnage Limitor"—the latter is a new device designed to protect presses from overloads at any point in the stroke. Literature describing the movies is available from the E. W. Bliss Co., Canton, Ohio.

Patent Examiners Wanted

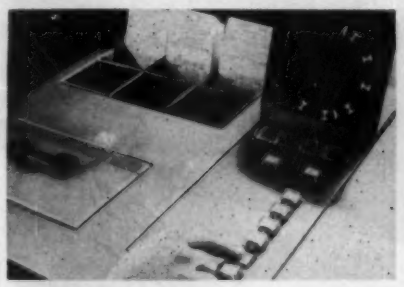
SEVERAL patent law associations are attempting to supplement the work of the patent office in recruiting new examiners. This step has been taken because of the seriousness of delays in processing patent applications filed during the past few years. The recent flood of inventions has stretched the average prosecution time per patent to three and a half years.

The New York Patent Law Association points out that the patent examiner holds a key position in the advancement of American technology and that the only way to reduce delays in patent processing and clear the way for market-

NEW concern, Production Machinery Corp., has been established to design and produce job-engineered machinery for the steel processing industry. Shown in the picture are D. W. Games, project engineer; N. J. Ranney (seated), president; and W. M. Colavitas, chief draftsman of the new company. The company will also offer its services in improving existing plant procedures—with particular emphasis on narrow strip processing lines and slitting and shearing machinery as incorporated with coil and sheet handling equipment. Ranney was formerly director of engineering and purchasing for the Wean Equipment Corp.

ing new products and processes is to employ new patent examiners to pass upon the backlog of applications which are piling up in almost every technical field. Over 100 new patent examiners have been added to the examining staff since June of 1955 and it is understood that the Patent Office plans to build this number up to a total of 350 new examiners by the end of 1956.

However, there are immediate openings and an urgent need for engineers and scientists who can accept appointments as patent examiners. Engineers and scientists holding a college degree in engineering or applied science, or a degree with a major in chemistry or physics, or with certain combined credits in these fields are eligible for appointment as patent examiners without examination upon application to the Commissioner of Patents in Washington, D. C.



ELECTRONIC toll system developed by International Business Machines Corp. is used on new Ohio Turnpike. Recorder equipment located in toll booth totals individual axle weights and records number of axles as a truck approaches the turnstile. Weight is automatically determined for each axle as truck passes over a special weighing treadle; a photoelectric detector counts the number of axles.

Daily Review of Inventory With Automatic System

SAVINGS of $120,000 annually are expected by the Otis Elevator Co. as a result of adopting an automatic inventory control system. Basis for the control system will be a computer built by Nuclear Development Associates Inc. Machine will be used in controlling a $10 million inventory that Otis Elevator Co. must carry in building and servicing elevators in its world-wide operations.

The massive inventory is re-

Comar Plug-In Relays simplify replacement, speed up servicing, permit faster assembly, eliminate wiring error. Safety covers protect against shock and dust. Ideal for use in vending machines, mobile communications equipment, electronic computors, automatic pin-spotters, testing apparatus, etc. Maximum standard contact combinations up to 3PDT, (up to DPDT, UL). Also available without covers. Relays used are standard Comar components. Our engineers will show you how these plug-in types can best be applied to your requirements. No obligation.

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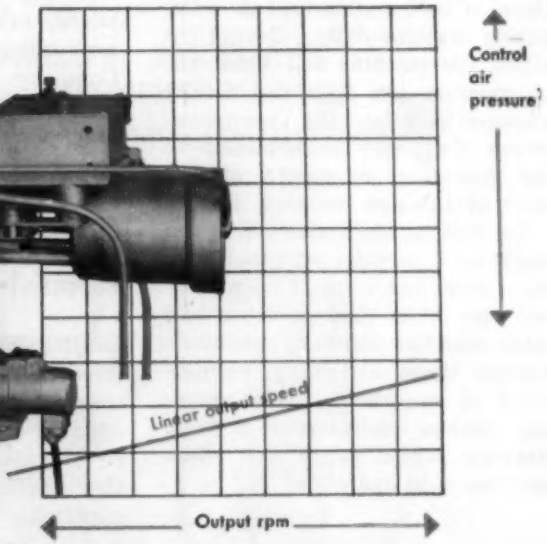

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1. Standard Pneumatic Controllers measure changes in heat, pressure and practically any other variables.

2. The slightest change noted by the controller is relayed by air pressure to the REEVES Motodrive.

3. The REEVES Motodrive automatically changes speed to compensate for changes in heat, pressure, etc., returning the system to equilibrium.

LINEAR OUTPUT SPEED—necessary to most control applications—assures exactness for proportioning and gives precise speed control *throughout the entire range* of the Motodrive.

REEVES AUTO-PNEUMATIC CONTROL

for regulating flow, pressure, heat, etc.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Division of **RELIANCE ELECTRIC AND ENGINEERING CO.**

quired because no two elevators are alike and Otis is prepared to service and maintain in good working order any elevator it has ever installed. This reportedly includes more than half of the elevator installations in the entire world.

Dr. Gregory Laserson, senior engineer at Nuclear Development Associates, director of the Otis project said that the computing system would automatically carry out the following operations: Keep a continuous up-to-date record of how much of each inventory item is on hand and how much on order, as well as the rate of use of the item over the past 15 months. Warn the company when and in what quantities to reorder each of the items and to keep a record of open orders. Provide a daily report for expediters on all items that are going on shortage and all contracts affected by these shortages. Provide information for scheduling production to meet contract dates.

In operation it is expected that typists will feed about 20,000 items of information into the computing machine daily. During the night, the machine will digest the information and feed the correct answers back into the typewriters where they will be available to the inventory managers at the start of the new working day.

To increase the reliability of the machine, a periodic marginal testing system has been set up to subject the 2,000 vacuum tubes and other sensitive points to conditions beyond those ordinarily encountered in operation. This procedure enables the detection of weak elements which might fail while machine is in operation.

New Solid Lubricant

PIONEERS in the field of solid lubrication, American Metaseal of Detroit, have introduced a new solid lubricant which they call "Metal-Film". Tests have indicated that it works on any and all metals. The lubricant can be used at extreme temperature and pressure range; on sealed and inaccessible bearings or assemblies; on bearings adjacent to any surface that cannot be contaminated by dripping lubricants; on mechanisms that operate intermittently over long periods; on parts where the environment would affect the average organic lubricants; and, on parts where dust and solvents present problems. Company engineers have designed a special oven for the baking process which is necessary in using this solid lubricant.

NON-DESTRUCTIVE testing of aluminum plate destined for the aircraft industry is possible with ultrasonic testing device designed and manufactured by Electro Circuits Inc. Slabs up to 48 feet long, 10 feet wide and 20 inches thick can be tested. Illustrated unit will be installed in rolling mill of Kaiser Aluminum & Chemical Corp. The 50-foot long device can automatically scan 100 per cent of the slab; mark location of flaws; and follow warpage or bows in the plate being inspected without need of adjustment.

Aircraft Overvoltage Relay Potential Industrial Item

DESIGNED primarily to meet an important aircraft need, a new overvoltage protection relay developed by Jack & Heintz Inc. should be of value to industrial automation applications by virtue of its simplicity and reliability. The rapidly expanding applications of ac electric power aboard new military and commercial aircraft has placed special emphasis on the reliability of overvoltage protection devices. A persistent overvoltage condition will cause premature failure of instruments and equipment and greatly increase the possibility of fire.

Until recently ac overvoltage circuits employing air-damped plunger type relays have proved the most satisfactory. But at the higher speeds, accelerations and temperatures of advanced flight, these relays do not function properly within the specified voltage limits.

The new relay is patterned after the ordinary fluorescent tube starter. It is somewhat more complex in construction, however, to enable the relay to handle ac and dc power simultaneously. The dual-power handling ability eliminates the need of rectifiers which are necessary to operate conventional overvoltage relays.

The physical construction of the new relay is as follows: A hollow metal cylinder is used for the cathode. A wire anode is contained inside this cylinder. Two arched metal contact straps are mechanically secured to the cathode, but are electrically isolated. A contact ring is attached to one strap for contacting the other strap when operation is required.

The relay is normally used in conjunction with a slave relay, a transformer and two resistors for obtaining the desired voltage levels and time delay characteristics. As an example of the relay in operation, a generator overvoltage is sensed and amplified by a transformer. This signal fires the relay. The current flow between

anode and cathode acts to heat the cathode. The temperature rise of the cathode is predetermined by design to insure a desirable time delay before circuit completion (it is thus possible to prevent nuisance tripping during normal system switching). As the cathode expands, it stretches the arched straps until both are in contact with the contact ring. This action completes the circuit and trips the slave relay in the generator excitation field circuit. The generator is then de-energized until the overvoltage relay is reset.

The new unit is sensitive to the peak voltage and can be used at any ac supply frequency where the ratio of peak to rms is greater than 1.3:1. The relay contacts are rated at 0.5 amps and 28 volts. The time voltage characteristic of the relay is repeatable within 10 per cent of the original time after an elapsed time of 10 seconds following operation.

Circuit advantages offered by the new relay—as compared to present overvoltage relay circuits include: All relay calibrations are unaffected by mounting, altitude or acceleration in any direction; by virtue of hermetic sealing, the relay is unaffected by humidity, fungus, dust, salt spray and other conditions normally detrimental to overvoltage relay circuits; conventional overvoltage relays require rectifiers to convert the ac overvoltage to dc for operation but the new relay senses ac directly and needs no rectifiers; and the new relay requires no stand-by power, whereas conventional sensing relays drain electric power continuously.

Results of Study of Automatic Business Machines

TO ANSWER the question, "What will the automatic office machine do to office employment in the next 5 years?" the National Office Management Association retained Drexel Institute, Philadelphia. After two years of study Drexel Institute reported:

Number of office machines (electronic and other) will increase at a rate limited only by the ability

FOR YEARS... PROCTOR & SCHWARTZ HAS BEEN A LEADER IN APPLYING CONTINUOUS PROCESSING TO THE TEXTILE, CHEMICAL, FOOD AND PROCESS INDUSTRIES

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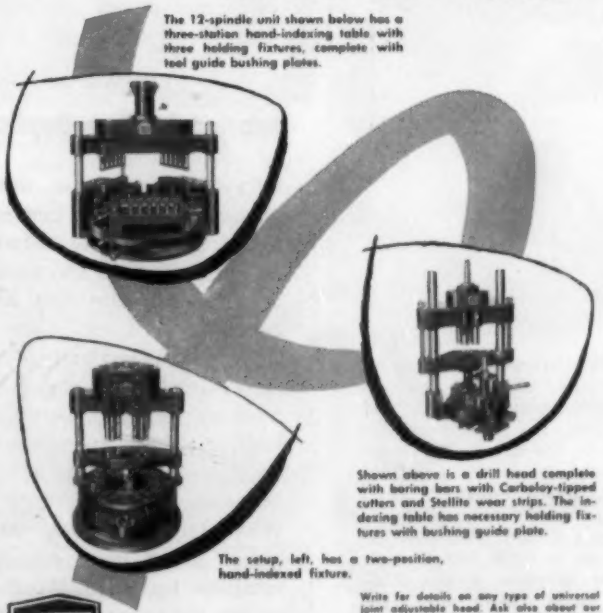
IT'S SAFER TO BUY
DRILL HEADS, FIXTURES and BUSHING PLATES
AS A COMPLETE PACKAGE

The 12-spindle unit shown below has a three-station hand-indexing table with three holding fixtures, complete with tool guide bushing plates.



Shown above is a drill head complete with boring bars with Carboloy-tipped cutters and Stellite wear strips. The indexing table has necessary holding fixtures with bushing guide plate.

The setup, left, has a two-position, hand-indexed fixture.

Write for details on any type of universal joint adjustable head. Ask also about our totally enclosed gear-driven adjustable, fixed center, or individual lead screw tapping heads.

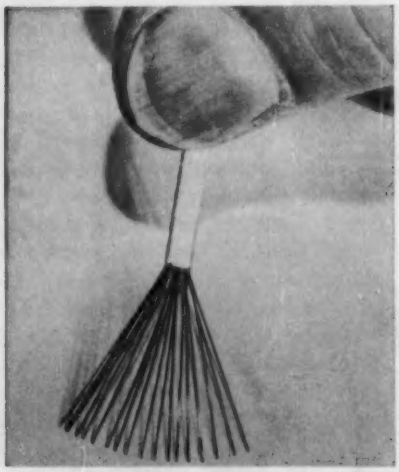
US HEADS
UNITED STATES DRILL HEAD COMPANY
616-618 BURNS STREET • CINCINNATI 4, OHIO

of industry to develop machines and of business to train operators.

Employment of machine operators apparently will double every 10 years for the next few decades. In 1960 there will be 300,000 office machine operators compared with 150,000 in 1950. Total office employment will have increased about 1,400,000 in the same period.

Men (who have been leaving office work in growing numbers every time there is an economic upswing) are being wooed back to the office by the machine. The number of women machine operators has remained static since 1950. Men operators have been responsible for all of the increase since then.

The office machine is placing a premium on experienced and trained office workers. The demand for skilled workers now exceeds the demand for unskilled workers—file clerks, mail clerks, receptionists, office boys, etc. And further economic upswing will produce a shortage of experienced workers.



WIRE brush, shown with strands spread apart, plays vital role in the operation of business machinery which process punched cards. The specially-tempered wire used in fabricating the contact brushes is made by the Worcester Wire Works Div. of the National-Standard Co. It is a tempered music spring wire with a tensile strength of 300,000 psi and is drawn to 0.008 inch diameter with a size tolerance of plus 0.000 inch and minus 0.0002 inch. The brush, consisting of the steel jacket and 18 strands of wire, measures 2½ inches in length, is less than 1/16 of an inch thick and ¼ of an inch in width.

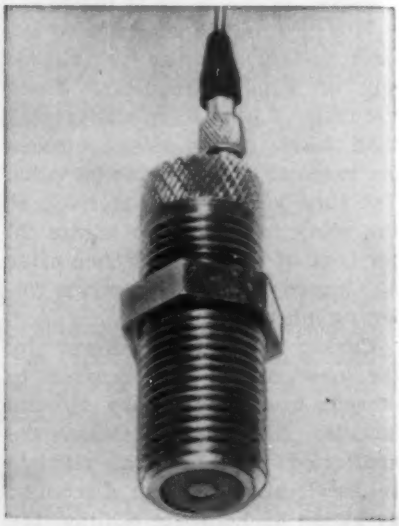
As to the machines themselves, the report states: "The optimism of the office machine industry is probably well deserved although impending changes cannot happen over night. Time is required to develop and produce equipment. Manufacturing costs must be reduced considerably to make such machinery practical for any but the larger companies. Many companies will hold off purchasing such equipment during the pioneering period and many other companies are probably too small to ever use electronic equipment economically. In addition, education is badly needed in order to learn how to use machinery more effectively."

Plans For Printed Wiring Board

PRODUCTION of one million square feet of printed wiring boards is planned for 1956 by the General Electric Electronic Components Department. According to **E. A. Malling,** department marketing manager, this figure should represent between five and six million individual boards. In the General Electric process copper wiring patterns are plated on plastic boards. Installation and proving-out of the printed wiring board production line in the General Electric new plant is complete and initial production is underway.

Improved Office Duplicator

OFFSET duplicator, designed for automatic control, has been introduced by Ditto Inc. Once the machine is loaded, the operator sets a regulator for the number of copies needed and then pushes a button. Automatically, the machine turns itself on, paper rises into feeding position, ink and moisture begin to flow, cylinders turn, and finished copies begin rolling out at the rate of up to 8000 per hour. When the specified number of copies have been completed, the machine turns itself off. As few as one, or as many as 25,000 copies may be duplicated automatically this way. Some of the features of the new machine include: Electric operating controls mounted on a single keyboard; paper is fed and finished copies are delivered face up at the front of the machine; paper ranging in thickness from lightweight to heavy card stock can feed through the machine without the need of manual adjustments; and special controls eliminate ink build-up on the rubber offset blanket by stopping both ink and moistening operation when paper is not being fed while the machine is running.



MINIATURE proximity impulse generator has been developed by Minatron Corp. The new unit provides a self-generated output voltage proportional in amplitude and frequency to the velocity of magnetic material moving in proximity to the sensitive end of the pick-up. When used with commercially available electronic counters, it provides an accurate means of measuring, counting, or detecting movement, vibration, or speed of a shaft or other moving part.

Limitations To Application Of Electronic Sound Absorbers

IN A SPEECH before the National Noise Abatement symposium at the Armour Research Foundation, **Mones E. Hawley** of the Radio Corp. of America discussed the development on an electronic sound absorber.

Hawley described the electronic sound absorber as a device which consists of a microphone, an amplifier, and a loudspeaker connected to form an electroacoustic feedback system that reduces sound pressure variations in the vicinity of the microphone. Possible appli-

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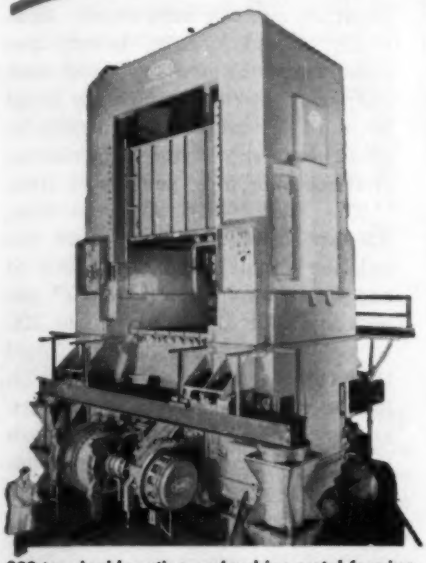
EDDY-CURRENT EQUIPMENT

is Solving Speed Control Problems in Every Major Industry

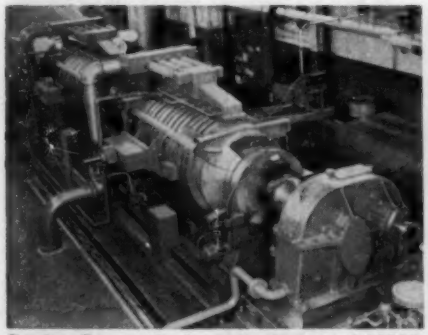


800 ton double-action under-drive metal forming press, driven by Dynamatic model 37-32 combination eddy-current coupling and brake.

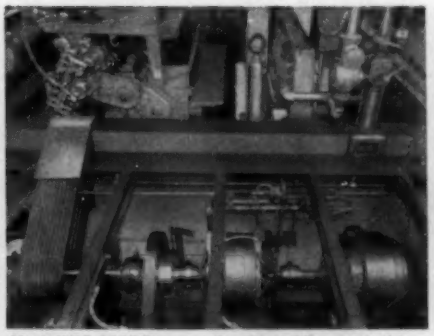
In practically all testing, processing, and conveying equipment common to industry, Dynamatic eddy-current rotating equipment is solving a wide range of adjustable speed drive problems, particularly where an AC power source is a requirement.

Advantages include rapid response, stepless adjustable speed control, wide speed range, quiet operation, low power loss, low maintenance cost, adjustable speed from an AC power source.

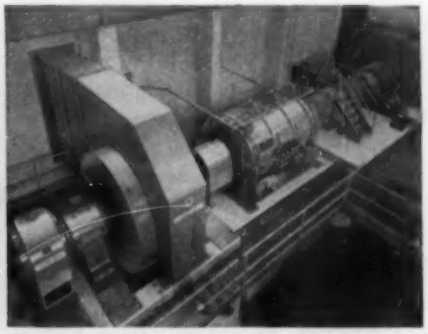
Send for Bulletin GB2, which describes and illustrates the basic Dynamatic eddy-current units, including couplings, brakes, dynamometers, press drives, and Ajusto-Spede® drives.



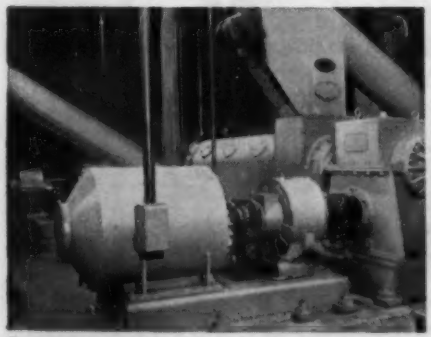
Tandem Dynamatic dynamometers, rated 20000 H.P., 600 to 5800 RPM. A cradled gear box permits turbine testing to 15000 RPM.



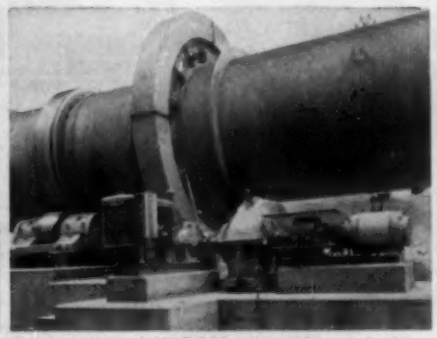
Model WC-1308 Dynamatic adjustable speed eddy-current coupling with eddy-current brake, used as printing press drive. Rated 20 H.P at 1700 RPM.



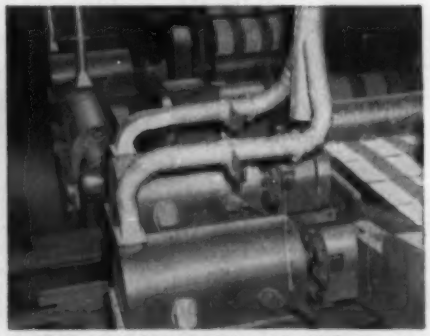
Dynamatic adjustable speed eddy-current aircraft wind tunnel drive, 18000 H.P. at 480 RPM.



Paper pulp washer driven by Dynamatic model WC-160 adjustable speed eddy-current coupling, rated 125 H.P. at 1100 RPM.



Dynamatic model WC-160 adjustable speed eddy-current coupling, rated 100 H.P. at 1100 RPM, used as cement kiln drive.



Roofing material machine driven by 23 Dynamatic Ajusto-Spede® drives. All drives and controls completely enclosed and force ventilated.

EATON

DYNAMATIC DIVISION
MANUFACTURING COMPANY
3307 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

cations of the device are: To reduce noise for a passenger in an airplane or automobile; to reduce machinery noise in the vicinity of the operator's head; and to reduce general room noise, as a muffler on an exhaust pipe, etc.

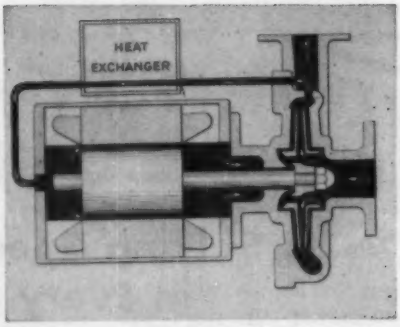
RCA recently has undertaken two contracts to apply the principle of acoustic interference to military problems. The first of these is with the Air Force's Aero-Medical Laboratory for a research program on the active ear defender. The other is with the Signal Corps for investigations of the possibilities of using noise interference techniques to improve speech communications in high noise levels.

A fundamental fact in the use of this acoustic interference principle, according to Hawley, is that in order to cancel a very high noise level—where the most severe problems occur—it is necessary to generate a very high noise level; in case of those extremely high noise levels which constitute a severe hazard it seems highly impractical to rely on acoustic interference alone.

Hawley explained that acoustic interference is merely another weapon to add to the armory in the fight against noise. It is a special situation weapon whose potential by itself and in combination with others is not yet fully known.

Metal Parts Cleaning

INDUSTRIAL washing machine capable of cleaning as many as 43,000 parts per hour has been designed by the Industrial Systems Co. for the Lewyt Corp. The new washing machine replaces a production process in which parts were hand washed in baskets. In a four-stage operation consisting of water washing, phosphate coating, water rinsing and drying, the industrial washing machine recirculates water at the rate of 193,000 gallons per hour and recirculates more than 5000 cubic feet of air per minute in the hot air dryer.



FLUIDS at temperatures as high as 1000F can be handled with new integral pump and heat exchanger designed by Chempump Corp. As in previous models, pump fluids enter the rotor chamber of the combined motor and pump. In this new model a secondary impeller, mounted on the rotor, circulates rotor chamber fluid through a water cooled heat exchanger mounted in the circulation line. Intermixing of hot fluid in the pump chamber and relatively cool fluid in the rotor chamber is very slight.

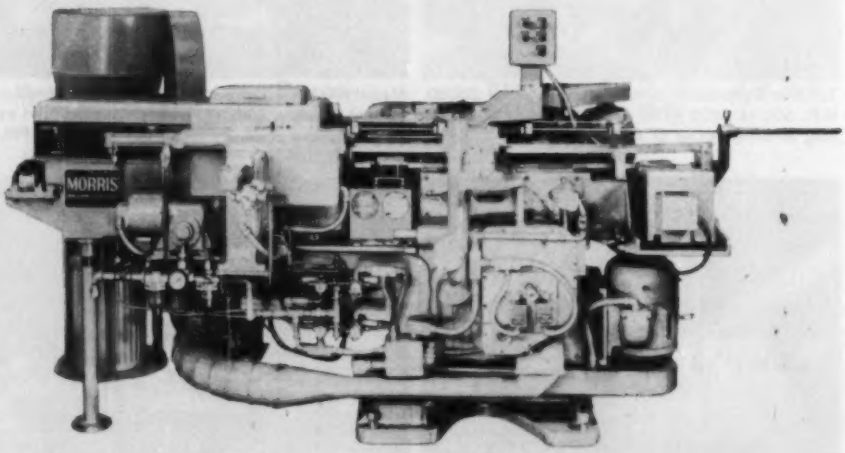
Cobalt-Iron Alloy Tests Prove Low Thermal Expansion

TESTS conducted by the National Bureau of Standards have confirmed that the thermal expansion of certain cobalt-iron-chomium alloys is extremely low and nearly constant between 20C and 60C. Thermal expansion and phase transformation studies on a number of these alloys were made by **Peter Hidnert** and **Richard K. Kirby** of the Bureau staff. These findings should be of interest to designers of equipment in which thermal expansion is important.

Scientists and engineers require low-expansion materials for applications in tools and machines, such as thermostatic and measuring devices, where some dimensional changes due to changes in temperature must be kept small. Generally, fused quartz, invar, and some ceramics are used for such purposes; but of these only invar is metallic, and it is subject to small but significant dimensional changes over long periods of time.

The alloy (36.6 per cent iron, 8.9 per cent chromium, and the balance cobalt) has coefficient of expansion less than 1×10^{-6} per degree C for the range from 20C to 60C. However, it was found that the low expansion of such alloys is very sensitive to small variations in their chemical composition. Also, some of the alloys undergo a transformation on cooling at low temperatures.

ESTABLISHMENT of a fellowship at the Cavendish Laboratory at the University of Cambridge, England, has been announced by Horizons Inc., an industrial and governmental research organization. The post-doctorate grant is for work in the field of physics and chemistry of the solid state and will be



FED and unloaded by conveyors, a new piston balancing machine has been developed by Morris Machine Tool Co. The new unit automatically receives, weighs, sorts, positions, clamps machines and discharges internal combustion engine pistons at production rates to 720 pieces per hour. It maintains piston weights uniformly to tolerances of plus or minus one gram. Pistons are automatically weighed. Grossly overweight and underweight units are automatically rejected from the machine. Pistons within the gross weight limits are weighed a second time. The machine automatically determines the amount of metal to remove from the trim pads, depending entirely upon the weight of the individual piston. The piston is clamped in milling position and is automatically milled to remove enough metal to bring its weight within the net weight tolerances.

done under the guidance of **Prof. N. F. Mott,** director of the Cavendish Laboratory. Fees, tuition, living expenses and other emoluments usually associated with such study grants are covered in the fellowship.

"Both industry and government research consciousness since the war has increased the need for scientific personnel so much that the demand far exceeds the supply," said **Dr. John T. Burwell,** Horizons' associate director of research. "In order to overcome this problem, Horizons Inc. has decided to actively assume the responsibility in assisting in the training of such personnel."

Tape Specialists

DEVOTING its efforts exclusively to the manufacture of magnetic tape is ORRadio Industries. The company produces a complete line of instrumentation tape for both computer and telemetering applications. The company's line of 50 different types of magnetic tapes include tape on acetate and Mylar films in 1200, 2400, and 4800 foot lengths and in ¼, ½, ⅝, ¾ and 1 inch widths.

Carbide Tips Aid Positioning

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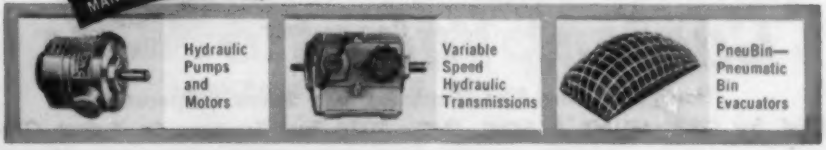

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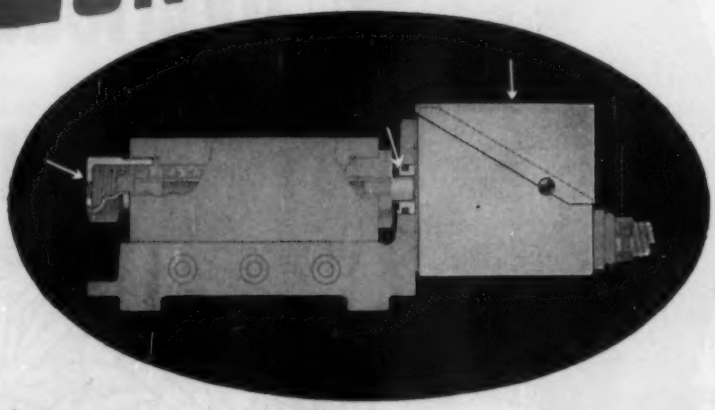

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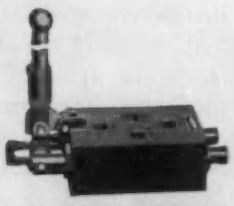

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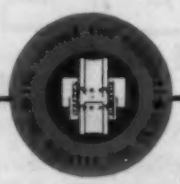

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and a larger area of each can remained unsprayed requiring increased hand labor in the retouching operation. The steel positioning arms have now been redesigned to include carbide tips and with the wear resistant quality of the tips, only two tiny areas remain to be retouched at the end of the spray painting operation.

MEETINGS AND EVENTS

Jan. 16-18—

Western Reserve University. Conference on the practical utilization of recorded knowledge to be held Western Reserve University, Cleveland. Additional information may be obtained from office of Dean of the School of Library Science, Western Reserve University, Cleveland 6, Ohio.

Jan. 19-21—

Institute of Radio Engineers. National Simulation Conference sponsored by Dallas-Fort Worth Chapter of IRE Professional Group on Electronic Computers. To be held Dallas, Texas. Additional information may be obtained from J. R. Forester, 2104 Huntington. Arlington, Texas.

Jan. 23-26—

Plant Maintenance and Engineering Show. Exposition and conference to be held Convention Hall, Philadelphia, Pa. Additional information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

Jan. 23-Feb. 2—

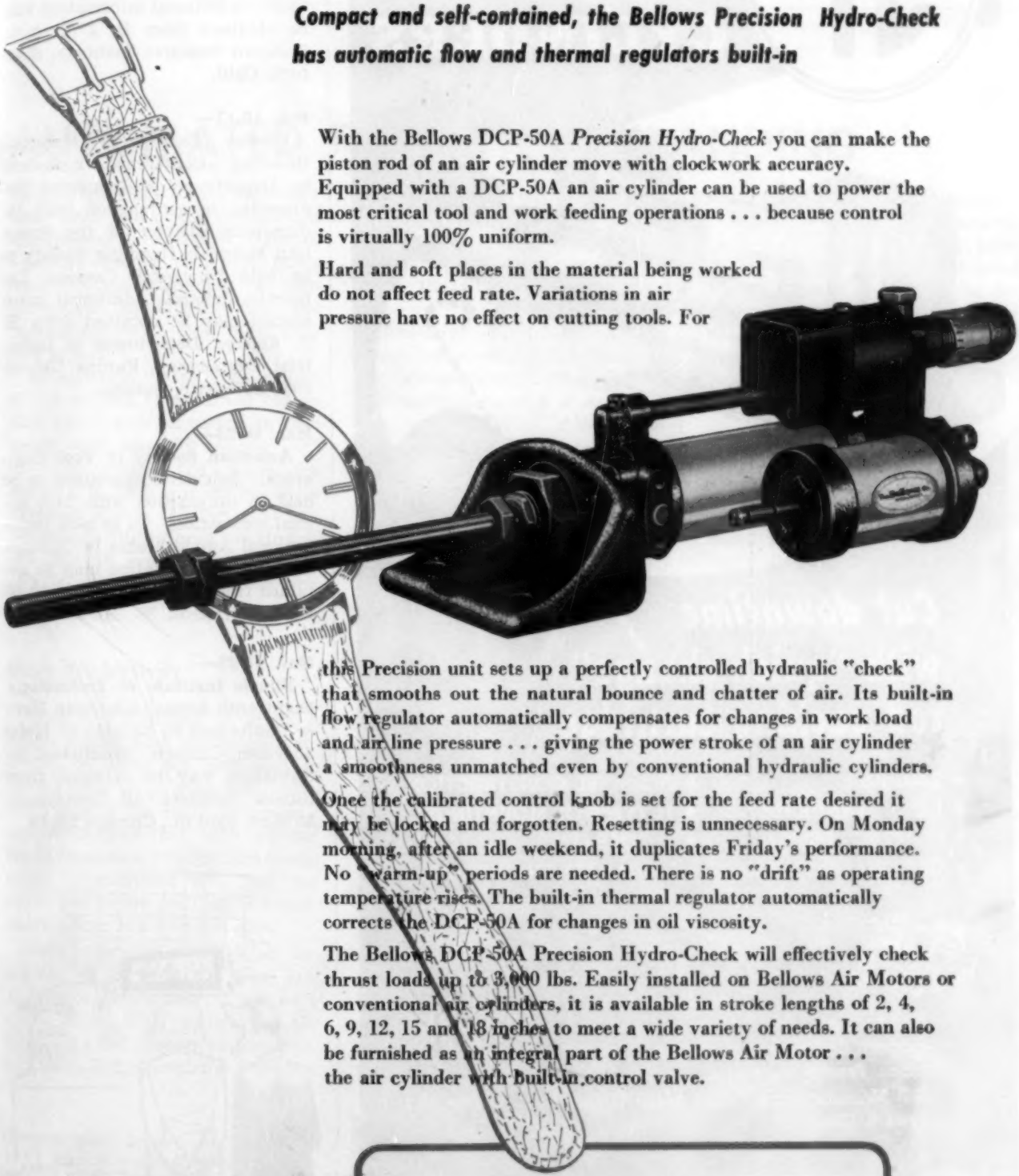
Engineering and Management Course. Special course for business executives offered by College of Engineering, School of Business Administration and University Extension of the University of California, Los Angeles. Additional information may be obtained from E. P. Coleman, University of California, Los Angeles 24, Calif.

Feb. 7-9—

Reinforced Plastics Division Conference. Eleventh annual conference sponsored by the Society of the Plastics Industry Inc. to be held Hotel Chalfonte and Haddon Hall, Atlantic City. Additional

This hydraulic unit controls air cylinder movement with *21-Jewel Precision*

Compact and self-contained, the Bellows Precision Hydro-Check has automatic flow and thermal regulators built-in



With the Bellows DCP-50A *Precision Hydro-Check* you can make the piston rod of an air cylinder move with clockwork accuracy. Equipped with a DCP-50A an air cylinder can be used to power the most critical tool and work feeding operations . . . because control is virtually 100% uniform.

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The Bellows DCP-50A Precision Hydro-Check will effectively check thrust loads up to 3,000 lbs. Easily installed on Bellows Air Motors or conventional air cylinders, it is available in stroke lengths of 2, 4, 6, 9, 12, 15 and 18 inches to meet a wide variety of needs. It can also be furnished as an integral part of the Bellows Air Motor . . . the air cylinder with built-in control valve.

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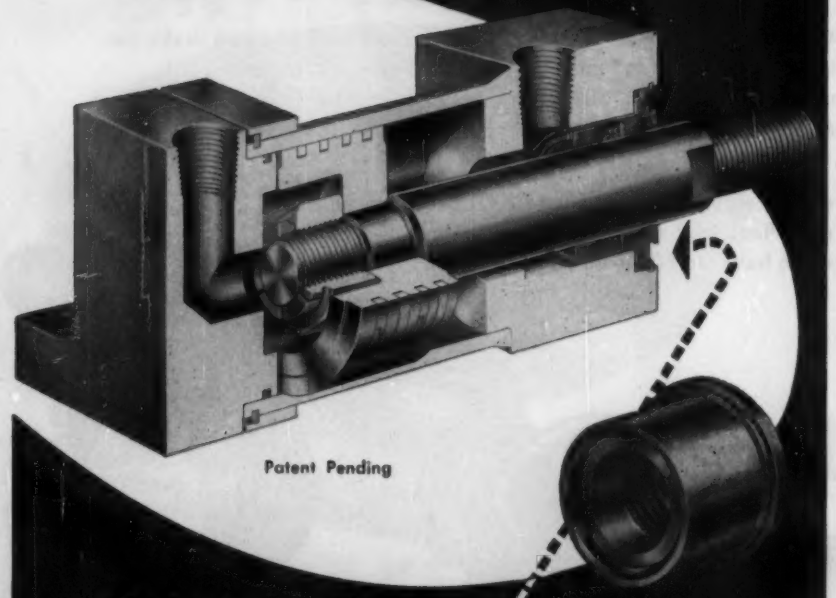

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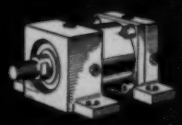

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information may be obtained from society headquarters, 67 West 44th St., New York 36, N. Y.

Feb. 8-10—

Western Joint Computer Conference. To be held San Francisco, Calif. Additional information may be obtained from B. J. Bennett, Stanford Research Institute, Stanford, Calif.

Feb. 16-17—

Purdue University. Materials Handling Conference sponsored by Department of Industrial Engineering in conjunction with Indianapolis Chapter of the American Materials Handling Society to be held University Campus, Lafayette, Indiana. Additional information may be obtained from H. T. Amrine, Department of Industrial Engineering, Purdue University, Lafayette, Indiana.

Mar. 19-23—

American Society of Tool Engineers. Industrial exposition to be held in conjunction with 24th annual convention. To be held International Amphitheatre in Chicago. Additional information may be obtained from Richard Gebers, 10700 Puritan, Detroit 38, Mich.

Mar. 21-23—

Illinois Institute of Technology. Eighteenth annual American Power Conference to be held at Hotel Sherman, Chicago. Additional information may be obtained from Illinois Institute of Technology, 35 West 33rd St., Chicago 16, Ill.

"It's something special for a machine shop in Nevada."

detroit dateline

By FLOYD G. LAWRENCE Detroit Editor

AUTOMATED FACILITIES EXPANDING

AS AUTOMAKERS turn the corner into 1956 with the production speedometer hovering at a record 8 million cars per year pace, many observers are beginning to view automaker prolificness like the horsepower race. How high, they ask, is up?

By contrast to the prewar high of 4.4 million cars turned out in 1929 and a year as recent as 1948 which saw only 3.9 million cars hit the roads, the 8 million spawned in 1955 is awesome. More awesome still is the fact that had all manufacturers been working at capacity all year, better than 10 million cars could have been produced.

More Productivity

With this situation in mind, it seems logical that the automakers would be about as interested in productivity as is a cooked rabbit. But capping the cockeyed portrait are indications that 1956 will set an all-time high in plant and equipment expenditures and that the next five years will be substantially above the five just past.

Take Chrysler Corp., for example. In the ten years from Jan. 1, 1946 to Jan. 1, 1956, it will have spent about $750 million for the expansion and modernization of facilities. But Chrysler's President L. L. Colbert announces $1 billion will be spent *not* in the next ten years which would be a one-third increase, but in the next five . . . more than double the previous rate.

Similarly, Ford Motor Co., which has spent $1.65 billion during approximately the same period, will increase its rate of expansion and modernization. Already announced is a program to spend $1 billion during the next three years, half in 1956 and the remainder in 1957-58. Some observers figure that when 1959 rolls around, Ford will have bettered in three years its figure for the last ten by a considerable margin.

And that's independent of another $1 billion committed for new tooling, which means that by the end of 1957, Ford will have spent or committed more than $3.75 billion since 1946 on new tools and new, expanded or modernized manufacturing and assembly facilities.

Then there's independent General Motors Corp.—cheerfully turning out half of the nation's motor cars annually—which has spent about $4 billion during this period for expansion and modernization. It can safely be predicted that Harlow Curtice, GM president, will announce an unprecedented expansion figure this month at Motorama to help his firm in its struggle to keep up with customer demand.

American Motors Corp., scoring Nash and Hudson separately prior to the merger, has invested more than $175 million in facilities development since the war. Studebaker-Packard has chalked up $100 million in just three years under James J. Nance's leadership.

Expand for the Future

In explanation of this trend, Ernest R. Breech, chairman of the board at Ford, says Ford is making a "whopping big bet on the future" because of its belief that "a great many people, including businessmen, may have failed to gage accurately the tremendous changes that have been taking place in our American economy." He reports that "the dream we have all been anticipating for the early 1960s is no longer a distant dream" and that we have "no choice but to prepare for a major breakthrough into a higher plateau of production and consumption."

Stephen M. Du Brul of General Motors Corp.'s business research staff translates that into figures indicating that highway traffic should double in the next 30 years and triple if highway improvement is stepped up. And in just the next ten years, motor vehicle registrations are due to increase more

Ground was broken in September 1953 for the original 960,000 square feet of Ford's stamping plant at Walton Hills, O. Operations began August 1954. First addition was 300,000 square feet. Current expansion will increase floor space to 1,500,000 square feet

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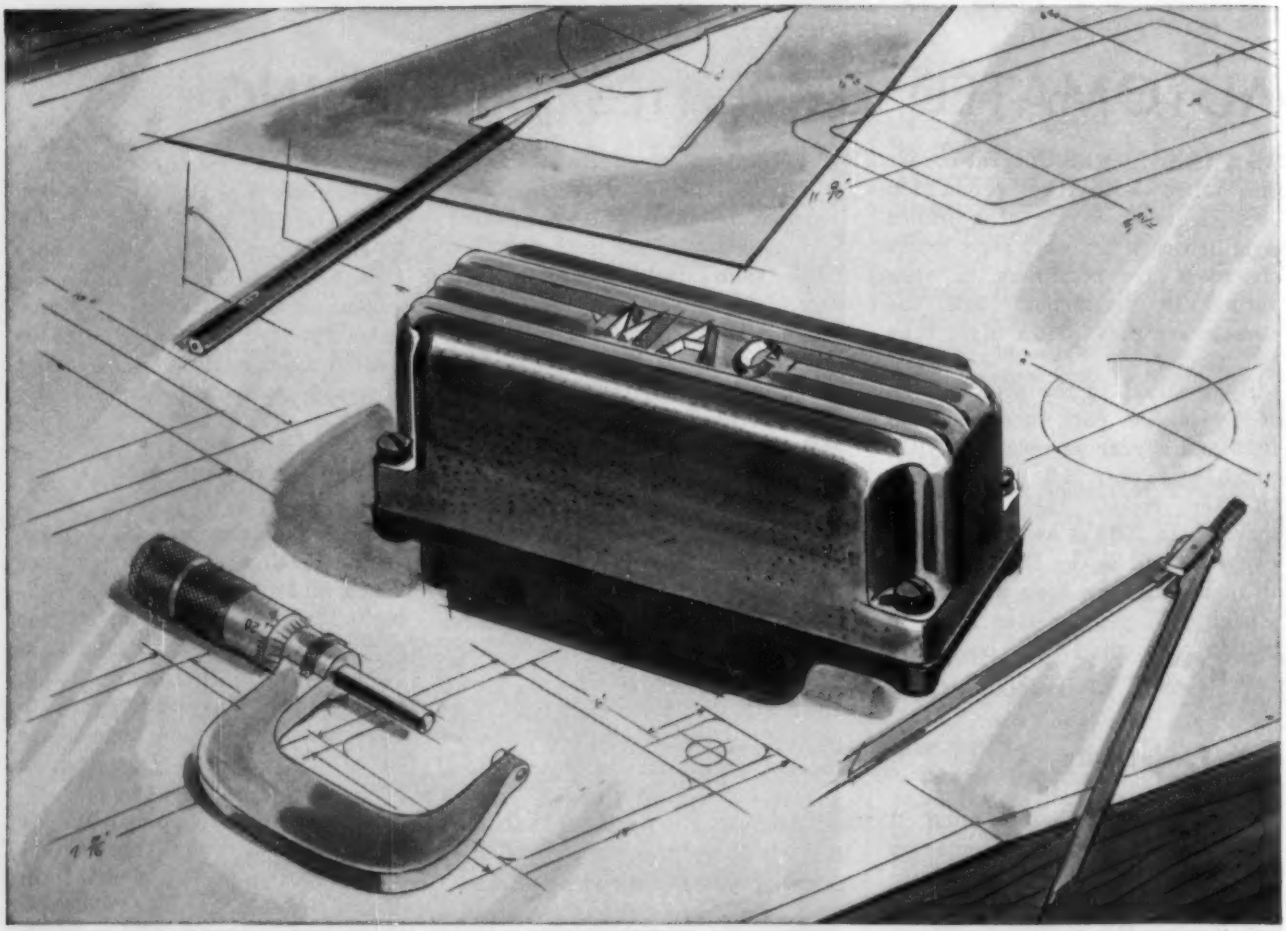

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than 33 per cent.

Increasing Markets

Spelling it out another way is Mr. Colbert of Chrysler. In his view the one-car family will be a minority in 1975. In fact, a large number of families will be using three or more cars. He notes that 14 million families still do not own an automobile and that two out of three women have not learned to drive. Close to 6 million cars on the road were built before World War II. In the years ahead, Mr. Colbert estimates 4 to 5 million must be built just to replace those that are being scrapped.

Factors like these lead the automakers to view the 1955 output of 8 million cars as more than a temporary phenomenon. But more specifically, each company is viewing its own expected market rather than the industry's market when setting forth its expansion plans. It's fairly obvious that you can't sell cars you can't build, so the rationale of expanded facilities adds up. On the other hand, sometimes you can't sell cars you can build in which case the overhead adds up.

Big Money Question

That's the dilemma the automakers are faced with: The possibility of unused capacity versus demand which cannot be filled. Unused capacity, of course, is nothing new in the auto business. Seasonal fluctuation in demand coupled with the push to flood the market as quickly as possible with new cars following introduction have created this need in the past. And it's obvious that the more cost which can be taken out of the product through improved methods, the more cushion there is to absorb that kind of overhead.

Automation Outlook

Thus the automakers move ahead on what might be termed a capacity race which can only be interpreted as good news to the equipment builders supplying industry's biggest customer. And it's particularly true of the automation suppliers who are finding modernization of existing facilities, a new go-around of engine changes and automatic assembly progress adding to this basic growth.

But perhaps most significant of all is the statement of L. L. Colbert in this regard. Viewing automation as a "timely blessing indeed," Mr. Colbert notes that population will be increasing 20 per cent in the next ten years while the available work force will increase only by 6 per cent.

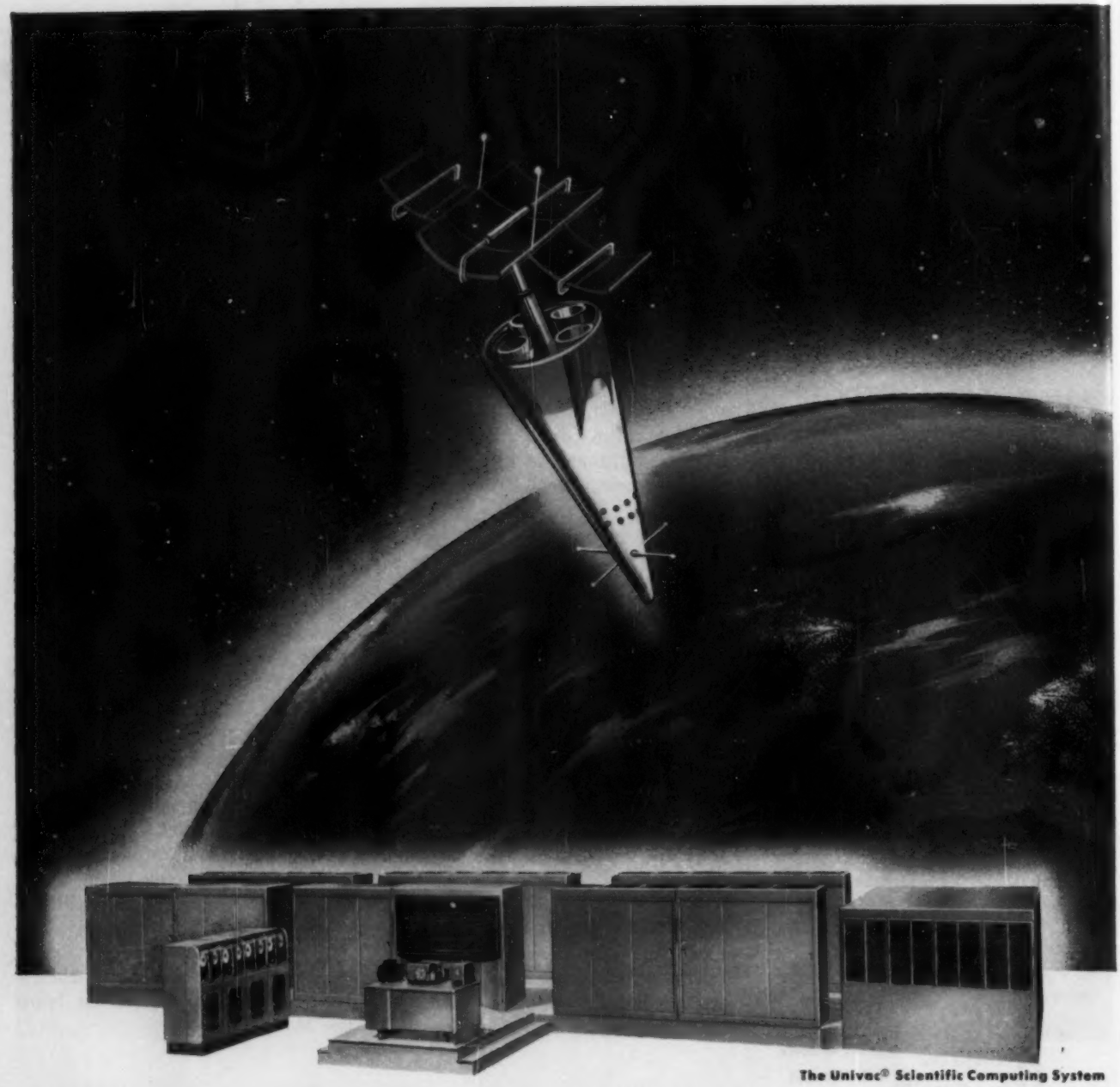
From every standpoint, the year 1956 and the foreseeable future look bright for automation from the Motor City.

Automotive Expansion

Industry-wide spending exclusive of new model tooling costs

*1956	$1800 million
*1955	1250 "
*1954	1295 "
1953	956 "
1952	896 "
1951	851 "
1950	510 "
1949	349 "
1948	474 "

*Estimated values — other figures from Dept. of Commerce



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Secrecy?

Not too many years ago, it was characteristic of businessmen to shroud their operations from interested eyes. Markets were different and most developments in production equipment were entirely the result of in-plant design or invention. Conditions often made secrecy simple and sometimes highly desirable for protection.

Today, the pace of industrial development and the vast changing market demand has divested operational secrecy of most of its earlier values. In fact, it is almost an axiom today that those who work to keep their operations and equipment secret accomplish little. They seldom do more than protect themselves carefully from reaping many of the benefits of modern developments and customer acceptance. Yet, we have encountered numerous instances where management is still following this archaic pattern.

Industrial plans and expansion into automation should be frankly and openly discussed, especially with the plant personnel and local community. Honest, forthright discussion will do far less damage to a concern than much of the distressingly shortsighted reluctance observed today. Secrecy concerning present operations and future plans can only be temporary and concealment of information can be more damaging than candor. The highest motives are suspect when discovered by accident or at an inopportune moment.

It is important to recognize that the very heart of automation evolution is inexorably tied with the cross breeding of industrial operations. Today, most production equipment is built or developed by specialists. To attempt to negotiate secretive agreements with builders, as has sometimes been the case, is not only out of tune with present industry standards but practically a request for the builder to go out of business.

At today's operating scale, no concern can afford to resort to secrecy. By the time a competitor has learned of a new production innovation, the live-wire company has advanced another step. He who waits to copy may well lose his place in the market. But the value to industry and the consumer, through general advance afforded by increased overall knowledge, is immense. In addition, great savings in operations can be made. There is no time or place today for secrecy!

EDITOR

Product form is often a compromise between the situation that is most convenient for the producer and the conditions that best suit the customer. When improved techniques can be of mutual benefit, as in the case of coiled sheet steel, both producer and customer stand to gain by the use of automatic operations

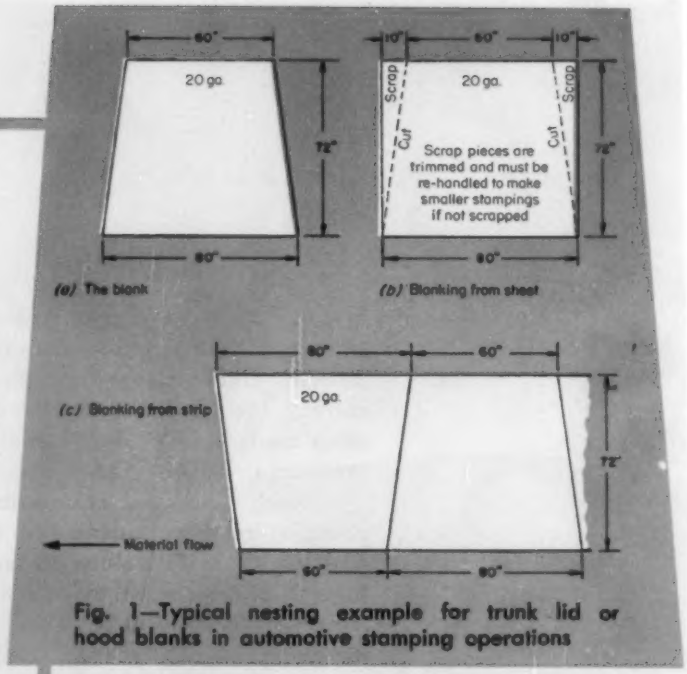


Fig. 1—Typical nesting example for trunk lid or hood blanks in automotive stamping operations

By JOSEPH F. LYDEN
McKay Machine Co.
Youngstown, Ohio

AUTOMATION APPLIED TO SHEET METAL BLANKING

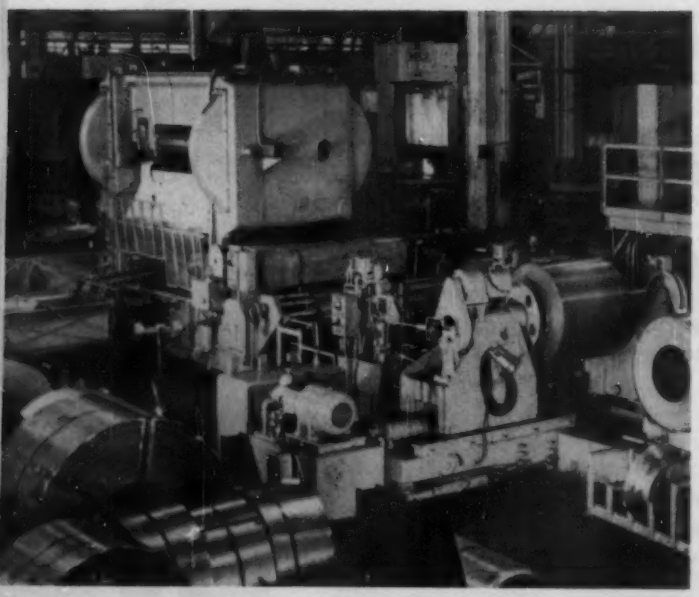


Fig. 2—Large coil feed line. Units from right to left shown in the line are: hydraulic coil loading car, cone type coil holder, pinch and brush roll unit, looping pit, feeder leveler, and blanking press

ONE INSTANCE where considerable savings have been achieved in automated operations is in the use of coil stock to feed continuously operating machinery and thus replace hand feeding of precut sheets.

First efforts toward fabricating and warehousing of sheet metal from coil stock took place in the 1930's. This process became feasible when the steel industry converted to the operation of continuous strip mills. The original product of the continuous strip mills was coiled material, but the mills were then called upon to convert these coils into sheet stock saleable to the fabricating trade.

These developments set the stage for stamping engineers to capitalize on the use of coiled strip in their blanking operations. Major reasons for this conversion were as follows:

1. Steel is less expensive to purchase in coils than in sheet form since mill extras for shearing and skidding are not included in coil prices.

2. Strip steel is adaptable to the nesting of blanks and thus allows better material utilization, *Fig.* 1.

3. Blanking from strip implies an automated process. Properly designed equipment can reduce labor expense per part.

4. Automatic feeding of a press is safer than manual feeding of same.

For example, let us compare the economies of blanking from sheets to blanking from coiled strip in a situation typical of the automotive industry.

▶ Material and Time Savings

Assume we're blanking from 20-gage steel a shape illustrated in *Fig.* 1. Comparative values are shown in TABLES 1 and 2. If we blank from a sheet, we'll need a sheet measuring 80 x 72 inches, weighing approximately 60 pounds.

Blanking from this sheet leaves two pieces of scrap weighing together about 7.5 pounds. If we assume that we can salvage 3.5 pounds of scrap per panel, we are left with 4 pounds of unsalvagable material.

Assuming an annual production of 500,000 panels, we will lose around 2,000,000 pounds of steel in scrap. If the cost of steel is $150 per ton and the selling price of scrap is $30 per ton, the net loss when using sheets is $120 per ton of scrap, or $120,000 total.

The yearly weight requirement for blanking from sheets is 300,000 hundredweight. Applying a mill extra charge of $0.20 per hundredweight for cutting sheets, there results an added cost of sheets versus coil of $60,000 per year. The loss on coil ends for coil operation would amount to only $7920 (one-half per cent of total tonnage). Even then, the material cost in coil is $172,080 less than in using sheets.

In blanking from coiled strip, length of feed will be 140 inches. A press with automatic feed can run at 16½ strokes per minute, producing 33 panels per minute maximum. At normal 75 per cent efficiency, the press will produce 24.75 panels per minute, or 1485 panels per hour. An automatically fed press requires only two operators.

In using sheets, on the other hand, the press is slowed down to a maximum of 7 strokes per minute which, at normal 60 per cent efficiency, means a production of 252 panels per hour. Four men are needed to operate the press (two loading, and two unloading and stacking).

Thus, a "cost box score" might read as shown in TABLES 1 and 2 indicating a material savings of $172,080, a machine-hour savings of 1647 hours and a man-hour savings of 7262 hours.

Note that the man hours it takes to produce the panels by feeding sheets manually to the press are nearly 12 times that taken when using automatically fed strip. Also, using the figures given in this case, the manual feeding method requires $331,350 more to purchase material than does automatic feeding of coiled strip.

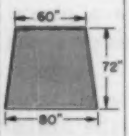
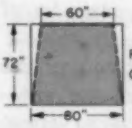
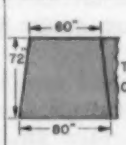
In a more complete cost comparison it would be necessary to consider also such costs as machine setup, material delivery and inventory charges that are part of the production scheduling decisions that affect production costs.

▶ Equipment Requirements

The art of blanking and shearing coil stock is more complex in the wide applications (36-inch

TABLE 1

Comparison of Material Costs

		Part	Cut Sheets Stock			Coil Stock	
			 Rectangle 72"x80" Contains 40 sq ft			 Trapezoid 69/80 x 72" Contains 35 sq ft	
		Col "A" Part	Col "B" Scrap	Col "C" Salvage	TOTAL Sheet Method A + B + C	Col "D" End Loss ½%	TOTAL Coil Method A + D
Weight per panel 20 gage sheet (1.5 lb/sq ft)		52.5 lb	4.0 lb	3.5 lb	60 lb	0.264 lb	52.764 lb
Total weight for 500,000 panels	Pounds	26,250,000	2,000,000	1,750,000	30,000,000	132,000	26,382,000
	Tons	13,125	1 000	·875	15,000	66	13,191
Cost of materials ($150/ton)		$1,968,750	$150,000	$131,250	$2,250,000	$9 900	$1,978,650
Extra mill charge for cutting sheets ($0.20/cwt purchased)					$60,000		
Total purchase price					$2,310,000		$1,978,650
Resale value of scrap ($30/ton)			$30,000			$1 980	
Total credit to job (scap resale + salvage)			$161,250			$1 980	
Net cost (purchase price – credits)					$2,148,750		$1,976,670

MATERIAL SAVINGS BY COIL STOCK METHOD $172,080

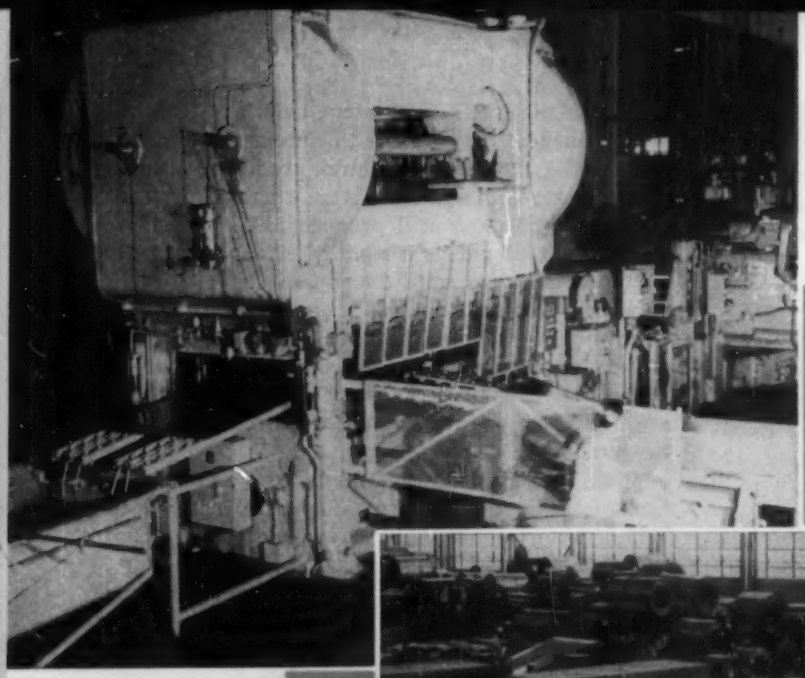
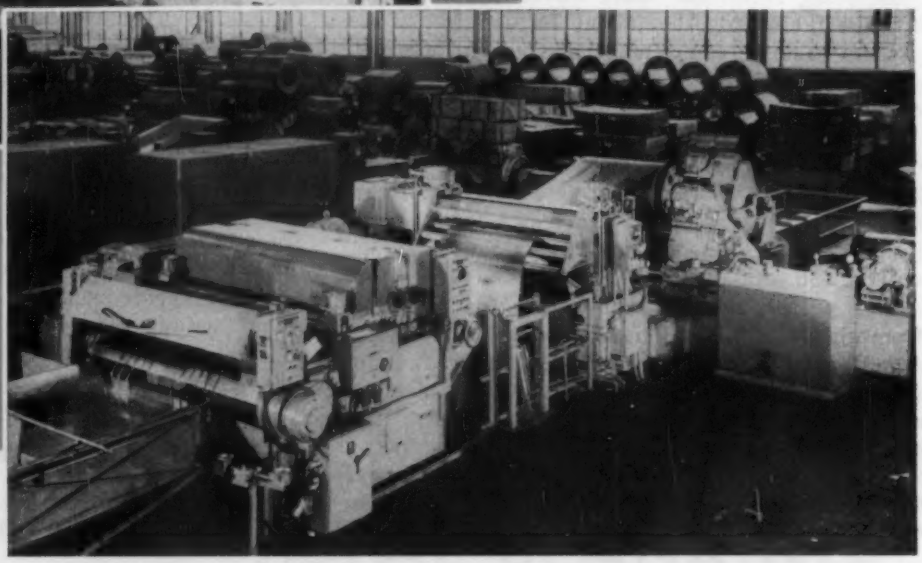


Fig. 3—View of press unit in the line of *Fig.* 2 showing how blanks are ejected alternately out the front and side so that each stack of blanks will be properly oriented

Fig. 4—This line is similar to that shown in *Fig.* 3 except that it uses a squaring shear to cut the blanks instead of a press



strip width and greater). Several types of wide equipment will therefore be discussed to bring out some important design features which may be of interest.

External panels used by the automotive and the appliance industries are in this large size category, and surface finish of the metal in these panels is important. This means that coils should be suspended from their internal diameters either with cones or mandrels to prevent damage to the metal as it unwinds. Cone type coil holders are most often used on heavy coils since they can adapt to a greater range of internal diameters, can be used to load egg-shaped coils, and are capable of centering the coil after it has been loaded.

Most coil feed lines include a machine for pulling the strip from the coil holder. This machine may be a pinch roll unit or it may be a pinch roll combined with cleaning equipment designed to completely wash the strip. Another alternate would be a unit capable of completely washing and flex roll processing the metal to improve its drawing quality. In any case, the basic purpose of this machine would be to apply tension against the coil holder and thereby uncoil the strip, subsequently feeding it into a storage loop. From the storage loop the press feeder or shear feeder must level the curvatures out of the stock and measure a given length of material into the blanking dies or shear knives.

A large coil feed line operating with an open-side blanking press is shown in *Fig.* 2. The units in the line are: (1) Coil storage rack with stand-by coil, (2) hydraulic coil loading car with another extra coil, (3) cone type coil holder, (4) pinch and brush roll unit that pulls steel from the coil holder and partially washes it, (5) looping pit, (6) press feeder including a roller leveler and measuring device, and (7) blanking press.

This type of line is intended to level and measure a given length of strip into the blanking dies while the press is in continuous operation. The feed must be accomplished during open die time, with the feeder being stopped while the dies are closed. The feeder is usually built to cycle on any length from 6 inches, minimum, to approximately 18 feet, maximum. Synchronism with the press is maintained electrically so that the feeder action is initiated as the dies open. A storage loop is necessary immediately prior to the press feeder to maintain constant payoff speed on the decoiling equipment and to insure accurate lengths.

In greater detail, *Fig.* 3 shows the press installation associated with the coil feed line already discussed. Notice that each stroke of the press cuts two blanks. One blank drops straight ahead onto a sloped conveyor, and slides down into a stacker. The other blank is automatically ejected at right angles to strip travel and slides down another conveyor into a second stacker. This press is equipped with a dc variable-speed drive. This permits the operator to regulate press speed thereby matching the exact capabilities of the feeder. Clutching of the press is eliminated since time required for feeding the strip can be increased if necessary, by decreasing the strokes-per-minute of the blanker.

Blanks by Shearing

The same type of coil feed line as previously shown with a blanking press, can be operated with a conventional squaring shear for producing rectangular or diagonally sheared sheet stock. Such a line is illustrated in *Fig.* 4. Considering all the methods available for producing sheet from coil, this type of line is most popular in the larger stamping plants. The fact that it is adaptable to either a press or square shear is one of the major reasons for its universal acceptance.

Most stamping plants using highly automated press lines experience major difficulties in the control of quality due to the presence of dirt and foreign material on the blanks as they enter the draw dies. This dirt may adhere to the dies causing surface marks on the stampings. These defects must subsequently be removed by manual grinding operations after the part is completed by the press line. Obviously, any press line shutdown for die repair is also costly since much equipment is involved in a continuous stamping line. Effective strip washing facilities have been designed into the press feed line shown in *Fig.* 5 to help eliminate this condition. High volume solvent oil sprays and special filtering equipment are the important cleaning features of the equipment.

TABLE 2

Comparison of Machine and Man-Hours	Cut Sheet Stock	Coil Stock
Press strokes per minute	7	16½
Panels per minute	7	33
Normal efficiency	60%	75%
Net panels per machine-hour	252	1485
Machine-hours for 500,000 panels	1984	337
Machine-hour savings		1647
Operators per machine	4	2
Man-hours for 500,000 panels	7936	674
Man-hour savings		7262

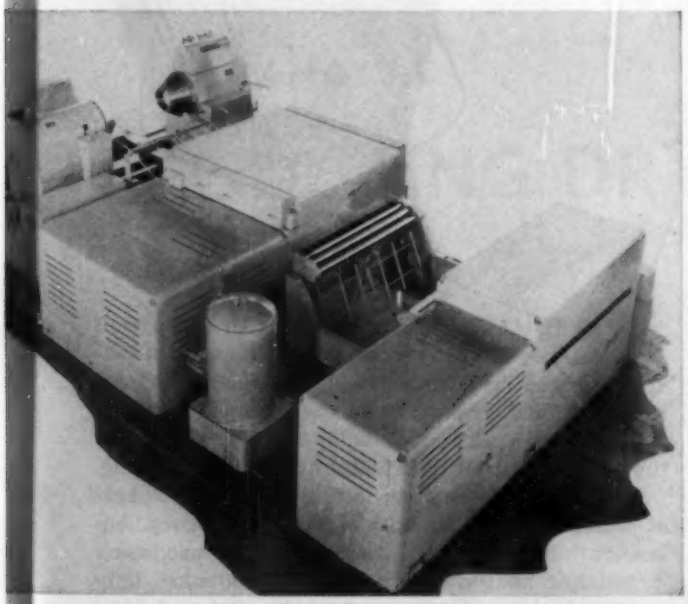


Fig. 5—To eliminate the possibility of creating surface marks and scratches, complete washing equipment can be installed immediately after the coil holder and thereby remove any foreign material that is adhering to the stock

Progress Solves Problems

At its earliest inception in the 1930's coil feeding of blanking presses represented one of the earliest and most successful automation attempts made by the fabricating industry. The methods and equipment originally employed for this purpose remained basically unchanged until industrial thinking was reorganized by the automation trend of recent years. Only then did it become fully apparent that costly limitations could be placed on a well automated press plant, both from the view point of production capabilities and of product quality, by incorrect application of coil feed methods. The most recent press feed lines incorporate new features in their design which eliminate the common sources for troubles which occur in older installations:

1. Marking of the strip in the coil feed machinery with resultant poor quality and/or extra metal finishing cost.

2. Passage of dirt on the strip allowing eventual trouble to develop in the draw dies, result being a shutdown of press line equipment.

3. Inaccuracy of feed machine which often makes subsequent handling of parts by automatic methods very difficult.

4. Substandard production rates due to the use of inadequate coil handling facilities cause the need for extra equipment, over and above actual plant requirements. The resultant loss of vital floor space is the major penalty of a short sighted approach in this matter.

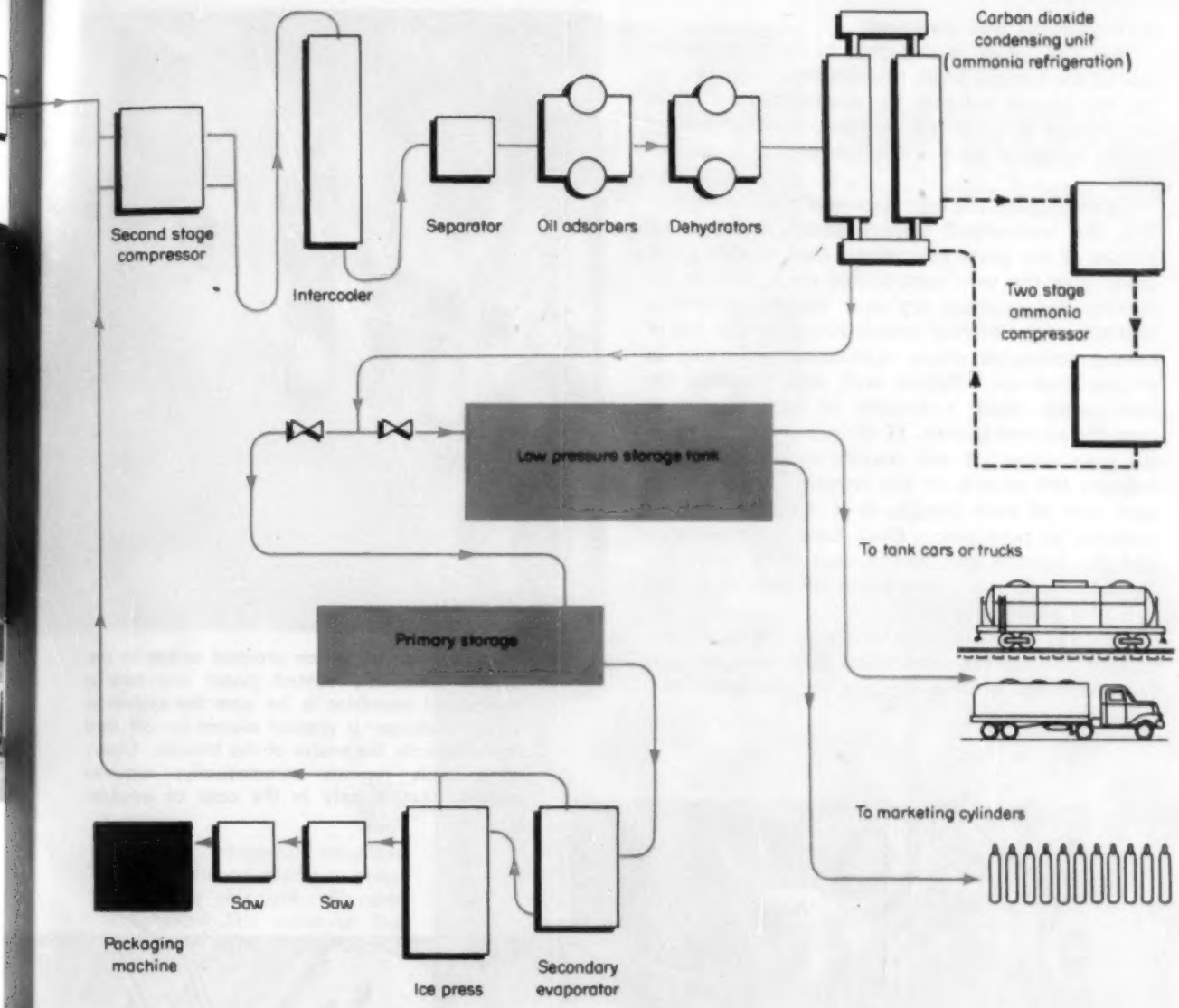
Processing of coiled material has retained its basic function; namely, the automatic production of shaped or rectangular blanks from strip steel. It is certain that subsequent problems of fabrication in automatic or semiautomatic lines have forced the application of many of these new ideas into the latest equipment designs.

1 View of the Oakland Calif. plant of the Liquid Carbonic Corp. The chemical scrubbing tower, stripping tower, and absorption tower (left to right) dominate the maze of pipes which together house the chemical separation and refrigeration processes used in the production of carbon dioxide (CO_2)

AUTOMATION TODAY

AUTOMATION'S development in the chemical industry is evolutionary in nature. As increased market demands give rise to the need for additional plant capacity the opportunity is provided to design and build processing systems that incorporate the latest automation thinking.

In a new one and a half million dollar plant at Oakland, Calif. the Liquid Carbonic Corp. engineers have designed a carbon dioxide producing installation that can turn out 50 to 60 tons daily using only two operators per shift. Shipped from the plant in liquid form in cylinders, tank cars or trucks or in solid form as packaged dry ice, the product which was once marketed almost exclusively to the beverage industry has in recent



PRODUCING DRY ICE

years found new uses that now consume about 80 per cent of the total CO_2 production. Refrigeration applications range from dining cars to rubber tumbling. Fire extinguishers, welding, and steel hardening are included on the list of uses.

This new plant burns natural gas in a boiler furnace which forms a flue gas that is about ten per cent CO_2. After being cleared and cooled in a water scrubbing tower, the gas is blown into an absorption tower where an organic chemical, monoethanolamine, is used to absorb the CO_2 gas out of the flue gas. This chemical has the ability to latch onto CO_2 from a gas stream and hold it while at ordinary temperatures. When the solution is heated in heat exchangers and in a stripping tower it readily gives up the CO_2 in a relatively pure form.

Potassium permanganate is a strong oxidizing agent and is used in the next step of the process to purify the gas. After being compressed to 300 pounds per square inch the gas goes through a more rigid purification process to remove oil and moisture. An ammonia refrigeration system is used to cool the gas and condense it to liquid CO_2. In this form it is ready for shipment in bulk or in cylinders.

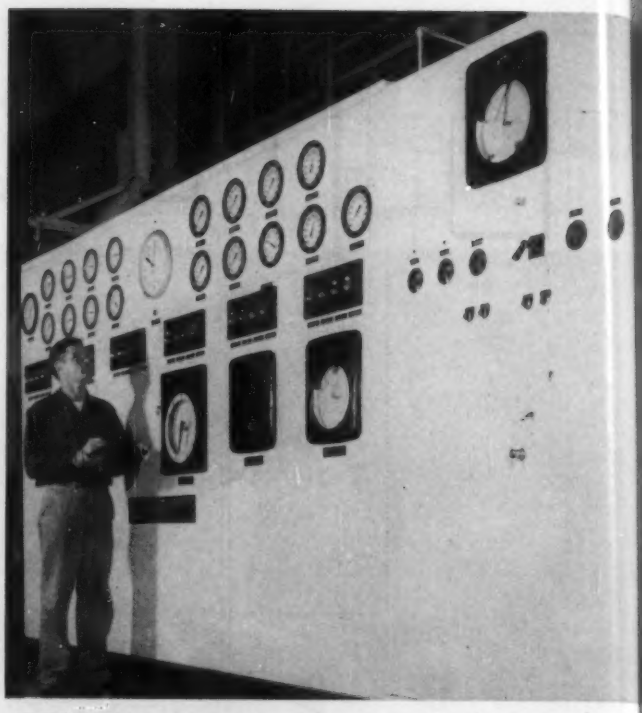
To make dry ice the liquid goes through several evaporation stages where it is further cooled and finally solidified into a snow. The snow is mechanically pressed to form blocks of dry ice, sawed

into quarters and packaged.

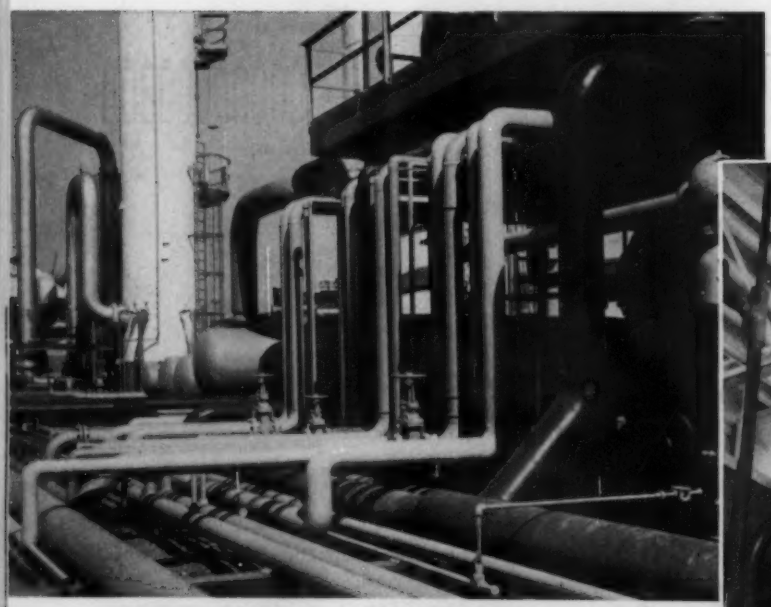
This CO_2 plant is designed to make maximum use of the burned basic raw material. By obtaining the proper balance, the system utilizes all of the carbon for the end product, and the energy in the steam is used either for power or process heat.

To accomplish the high degree of automated control the centralized control panel monitors all phases of the plant operation. Part of this panel takes over the very complicated cycle process for making and handling dry ice. Timers, pneumatic controls, and electrical relays attend to the job of having dozens of single operations performed in proper sequence. Before each step proceeds the instruments check a number of variables to be sure the system is safe. If all is in order the process goes ahead; if not, alarms sound and lights indicate the source of the trouble. Only in the rare case of such trouble is it necessary for an operator to take over. Even then, he must only find the trouble spot and correct it in order for the automatic cycle controller to take over and go ahead with the cycle.

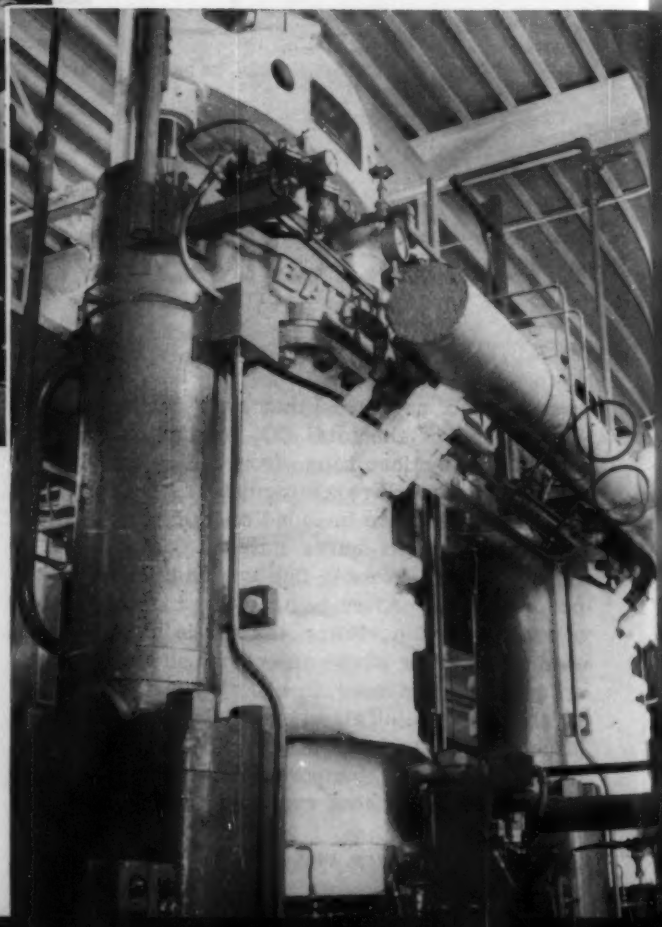
Since the manufacture of the liquid is a continuous process the ice making cycle is automatically repeated after each cycle is complete.



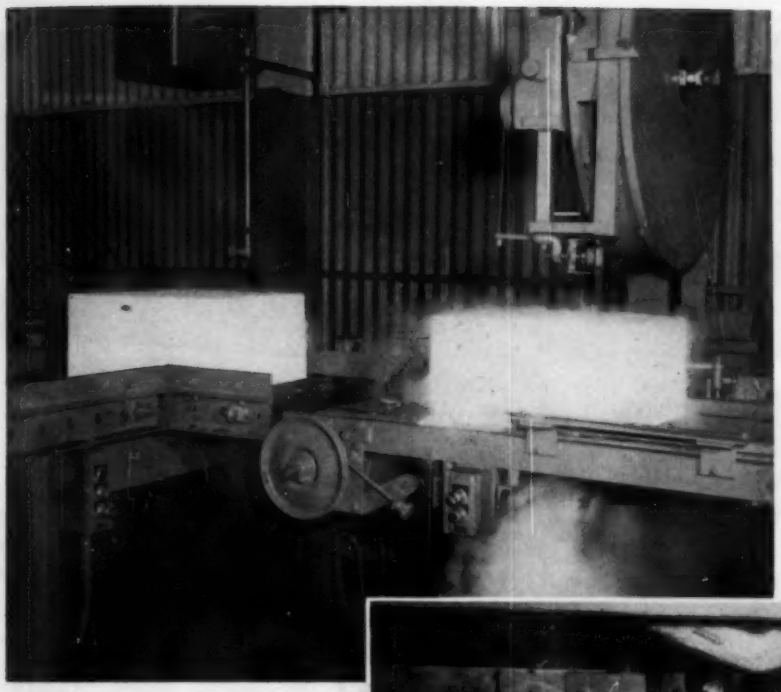
2 No single operation can proceed unless or until the automatic control panel monitors a number of variables to be sure the system is safe. If danger is present alarms go off and lights indicate the source of the trouble. Operating cycle repeats automatically, requires operator action only in the case of trouble.



3 Piping system used in processing 50 to 60 tons of CO_2 daily. Thirty-two different colors and shades are used to coat the pipes and identify the gases passing through. Towers and equipment are included in this scheme of color dynamics.



4 In making dry ice, the liquid goes through several evaporation stages where it is further refrigerated and finally solidified into a snow. This is mechanically pressed by one of two Baldwin presses to form blocks of dry ice.



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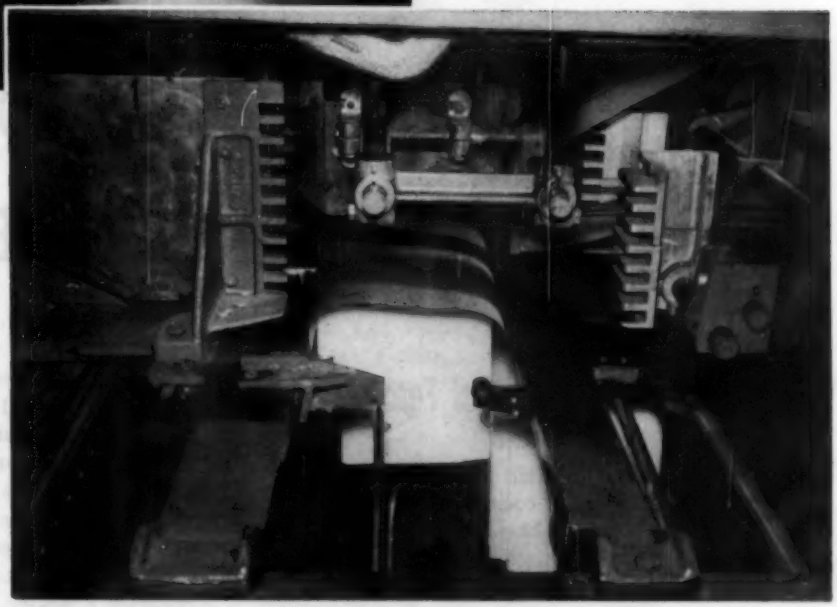
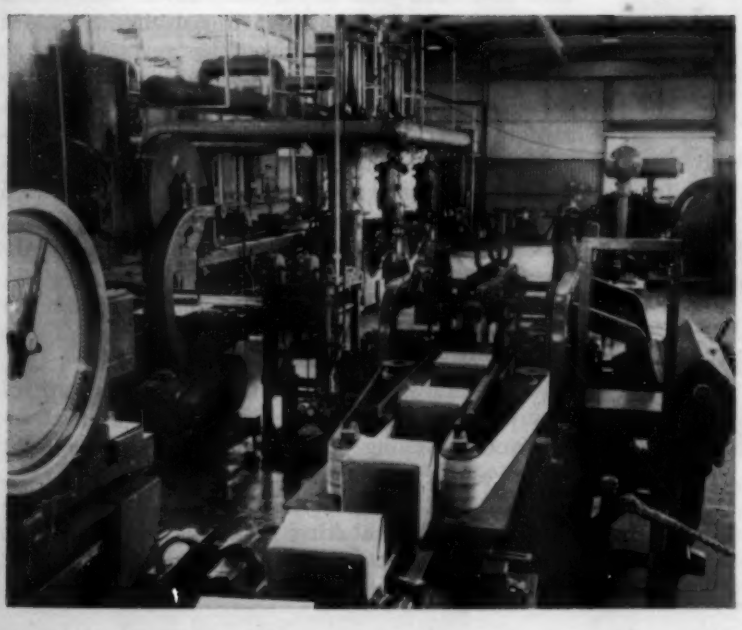
Conveyors move blocks of ice from the pressing operation to the first saw after which the material is moved at a right angle to the second saw.



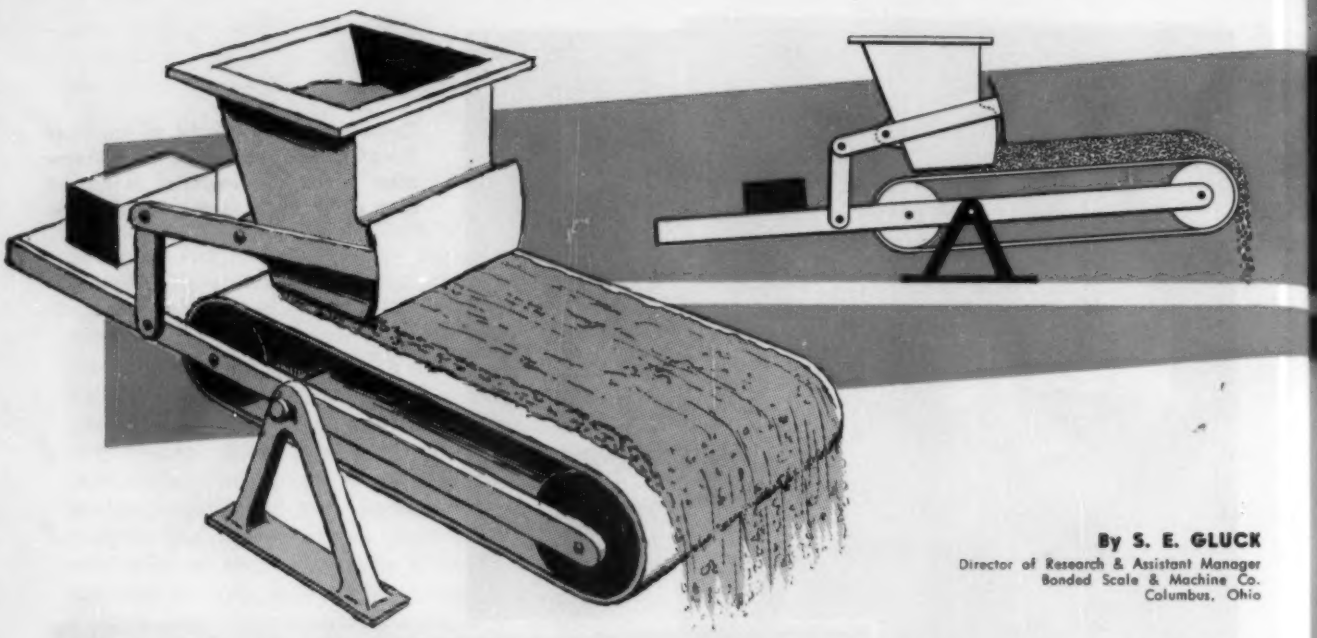
6

Automatic wrapping machines package the cut blocks in preparation for shipment. Elevator in machine lifts conveyor fed blocks into wrapping position.



7

View of dry ice processing section shows presses at the rear and conveyors leading to special bandsaws. The automatic system is completed by the wrapping and weighing machines in the foreground.



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WEIGHT CONTROL OF BULK MATERIALS

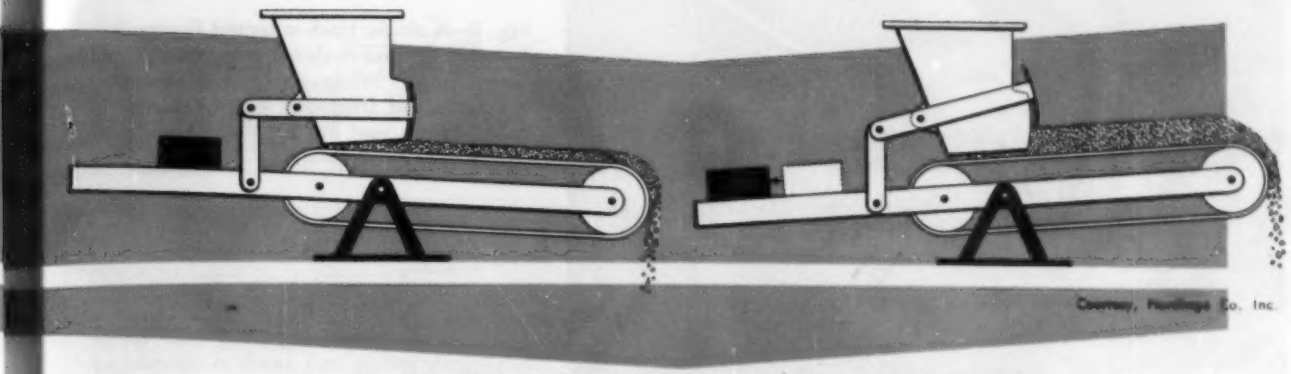
Part 2—Weight-control Feeders

CLOSE SIMILARITIES and essential differences exist between conveyor scales and the various types of weight-control feeders. A conveyor scale, installed so as to regulate belt speed, or to start and stop material flow onto a conveyor, converts that conveyor into a weight-controlled feeder. In Part I of this discussion it was also pointed out that blending of solids and liquids can be accurately controlled with conveyor scales. Blending can also be accomplished with weight-control feeders.

Uniform flow of bulk material at a preselected rate can produce tangible improvements in product quality and processing efficiency. Weight of material fed at some point in a processing or handling system can be manually or automatically controlled by means of controlled-weight feeders. Different types of feeders and some of their applications are pointed out by the author

The basic difference between the two types of equipment is that a weight-control feeder is not primarily a scale. It does not weigh the material first and then pass it on, but rather "learns and remembers" the weight of material already passed over it, and uses this constantly revised data to adjust future feedings so that overweight and underweight increments cancel each other over a period of time. The longer the run, the more accurate becomes the continuous series of such cancellations. Some feeders, however, are combined with an additional scale mechanism for checking, and such units are both weight-feeders and weighing feeders.

Three basic operations are performed by weight-control feeders. The first is pacing material flow from storage or stockpile into a production line. Of importance here is relatively uniform rate of flow within a prescribed range, rather than close-tolerance weighing. Thus while control by weight is convenient and efficient for such requirements, it is not the only possible method. A second application is the batching of a single material for processing or packaging and here accurate weight control is a necessity. The third use of weight-



Courtesy, Hardinge Co. Inc.

Fig. 1—Controlled-weight feeders can be simple mechanical devices which operate as shown in these views with constant belt speed: (a) When material density drops, a greater volume is fed; (b) when material density increases a smaller volume is required; (c) when the balance weight is shifted a new rate of weight feeding is obtained

feeders is the most delicate; i.e., continuous proportioning of several materials. This is especially sensitive where homogeneous blending is required —particularly of solids and liquids—or where proportions must be changed during processing to correct for variations in density.

Broad advantages of using a feeder are twofold. First and most apparent is the control of alternate arching and flushing of material. Uniform production with any hope of accuracy is extremely difficult if bulk material becomes compacted, and then when freed, floods a processing machine or packaging line. A weight-control feeder will not prevent arching and flushing in bins, but it does pace blend-disrupting surges. When used in conjunction with a bin vibrator, it effectively controls the arching. Compensation can also be made for a frequently associated phenomenon—changes in material density due to moisture or the presence of lumps in granular material.

The second broad advantage of using a weight-control feeder is less frequently recognized; this is the minimizing of wear and the power consumption of other machines. Conveyors subject to sudden drops of large quantities of material are strained in both belt and frame, the installation of special impact idlers notwithstanding. Crushers, grinders, and other material breakers are frequently damaged by choke-feeding, and there are some machines whose rate of speed depends upon the load they receive. The efficiency of grinding circuits is especially impaired by erratic material delivery. Screens and sifters, whether sizing solids or engaged in solid-liquid separation, will have their action damped by overloading. Mechanical overloads are costly power consumers, and all too frequently call the circuit breaker into action.

Weight-control feeders include constant-weight feeders, loss-in-weight feeders, and the previously mentioned applications of totalizing conveyor scales. Electrical and electromechanical weight feeders are chiefly of the vibratory type, use a lever system, and regulate material flow by varying the frequency of low-amplitude vibrations.

▶ Constant Weight Feeders

Hardinge Constant Weight Feeders, *Figs.* 1, 2, and 3, are especially suited to the mineral and chemical industries. They are rugged and compact, noted for low power consumption, and easy to install and maintain. Size for size, the va[r]ious models can replace older volumetric fee[d]ers with little or no change in bin construction and are well suited to track mounting as in *Fig.* 3. Capacities range from 1 to 100 tons per hour, and from ½-

Courtesy, Hardinge Co. Inc.

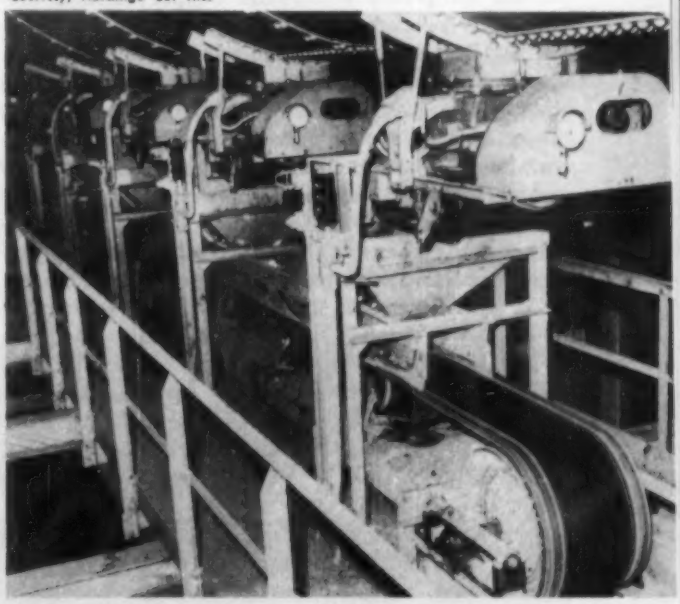
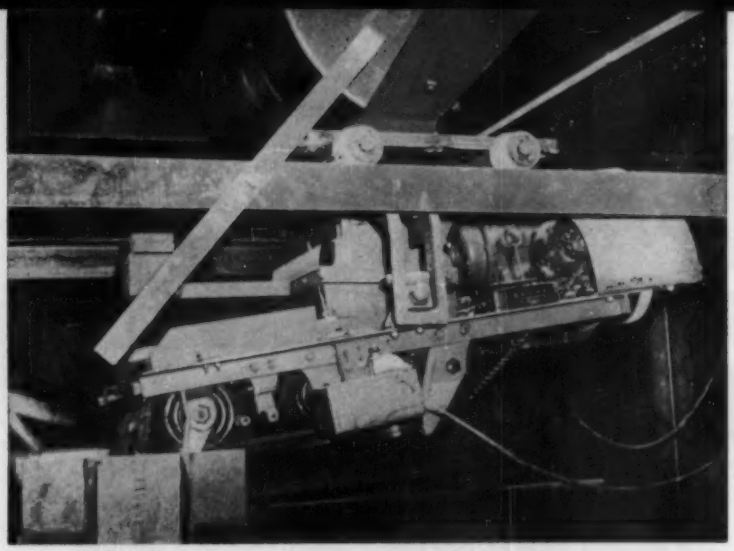


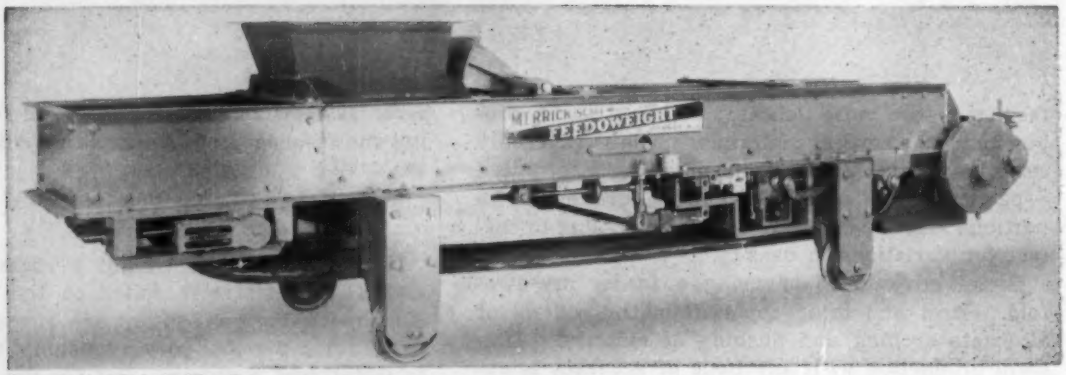
Fig. 2—In this installation 16 Hardinge Constant Weight Feeders discharge material to a single belt from overhead storage for 6000 tons. These feeders operate like those sketched in *Fig.* 1



Courtesy, Hardinge Co. Inc.

Fig. 3—A single track-mounted feeder can be used to feed material from several different bins. When the desired quantity has been fed from one bin the feeder is rolled to the next bin from which material is desired

Fig. 4—Another type of feeder varies gate setting and depth of material on the belt through a power regulator. Belt speed can also be varied to obtain constant rate of weight feeding. The Merrick Feedoweight shown is a feeder of this type



Courtesy, Merrick Scale Mfg. Co.

inch to 10 inches for maximum size of material. Where headroom is at a premium there is no need for additional feeder supports, because the feeder hopper is suspended from the bin. A traveling belt, built on a structural steel frame, is suspended on pivots below the hopper; and a mechanically operated gate is pivoted from the hopper and linked to the frame.

A change in the load on the belt is reflected in the position of the feeder frame, and the gate moves to increase or decrease the amount of material on the belt as illustrated in *Fig.* 1. Capacity may be changed by adjustment of the counterweights on the gate or frame, affording a three-to-one capacity range. The steel control gate is pivoted from the frame on ball bearings and connected to the frame on knife-edge pivots. Scrapers clean both surfaces of the belt, and adjustable skirt boards are used. A multiple-ply belt is used and has molded shrouds ¾-inch high on the sides to maintain clearance between it and the skirt boards. For material temperatures above 200F, a flat metal belt is used. Most models have hoppers of abrasion-resisting steel or Meehanite with a removable steel lining. Permanent magnetic pulleys can be installed for tramp-iron removal.

Individual requirements govern the choice of controls and recorders. Mechanically driven rate indicators show feed rate, totalize the weight of material passed by the feeder belt, and have dials that read directly in any convenient units of weight. An alternate system utilizes an electric tachometer driven from a small generator located on the feeder frame. Recording devices are applicable to both electrical and mechanical totalizers, and can be located independently of the feeder. Both continuous records and card-printed batch weights are easily obtained. All Hardinge feeders are equipped with a no-load cutoff, which automatically starts a feeder again when its belt is loaded. This cutoff actuates an alarm and can also automatically start a bin vibrator to correct arching. Entire blending circuits can also be regulated to halt other feeders and not destroy the blend. Applications of these feeders are shown in *Figs.* 2 and 3.

The Merrick Feedoweight, *Fig.* 4, is an adaptation of their Weightometer conveyor scale, and is built for almost any material and operating condition. It employs only one belt and requires very little headroom. It should be installed immediately below the storage bin or other source of supply, and the material supply must be maintained. In event of supply failure, a no-load cutoff device can give an alarm or stop all or part of the system. Models of this type feeder employ belts as wide as possible to keep belt speed low but obtain desired capacities. Wide belts allow large bin openings, thereby reducing the arching of material and often eliminating accessory bin-clearing devices.

Once the desired rate of feed has been set, the

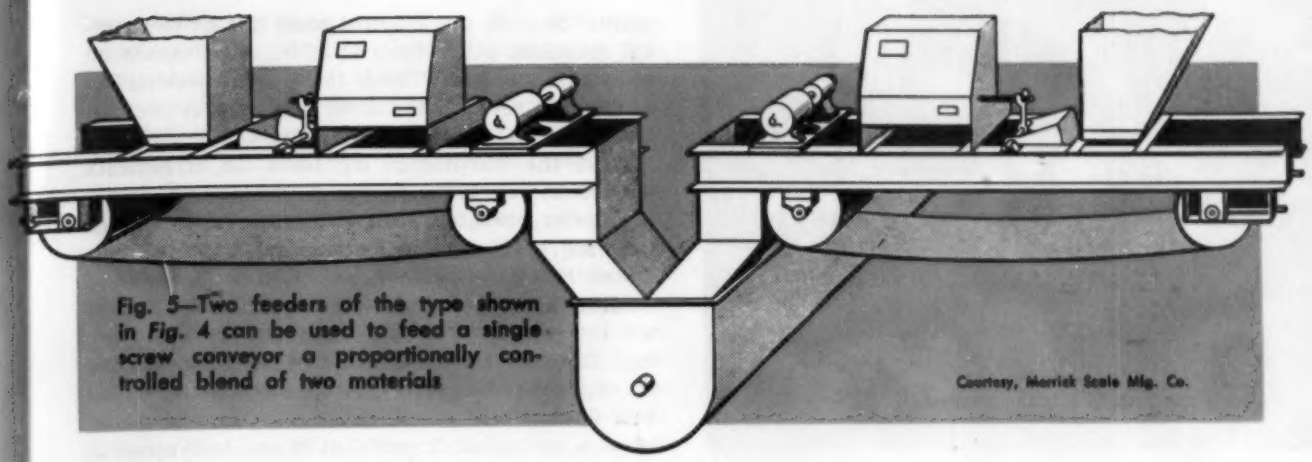


Fig. 5—Two feeders of the type shown in *Fig.* 4 can be used to feed a single screw conveyor a proportionally controlled blend of two materials

Courtesy, Merrick Scale Mfg. Co.

delivery of material by the Feedoweight is controlled by a power feed regulator which, while responsive to load changes, is not mechanically linked to the scale system. The actual weighing is done on the scale-suspended belt. The feed regulator, by means of a ratchet and pawl, positions the material releasing gate in response to what the scale beam indicates, but it operates independently.

Operating range of the standard Feedoweight is three to one. Maximum capacities range from 22 to 670 tons per hour with belts from 12 to 54 inches wide. These maximum tonnage figures are based on material weighing 100 lb per cu ft, moving at 60 fpm. Power consumption is quite low, the 54-inch belt model requiring only a 10-hp motor.

Feedoweight frames are formed of channel steel, and provide a mounting for all of the mechanism except remotely located controls and recorders. The weighing idler over which the loaded belt moves is suspended from the scale lever system, and restrained from responding to either forward or lateral motion of the belt. In addition, pivot blocks and main suspension rods are self-aligning, for uniform distribution of bearing loads. The multiple-ply rubber-covered belt moves over crowned steel pulleys, with the driving pulley lagged and the tail pulley equipped with screw takeups. Drive is at the head pulley. A way in which the Feedoweight is especially suitable for proportional blending of materials is illustrated in *Fig.* 5.

An example of an electromechanical constant-weight feeder is the Jeffrey-Traylor Waytrol sketched in *Fig.* 6. Here a vibrating feeder regulates the flow of material from a supply hopper, and the rate of operation of that feeder is automatically regulated by the weighbelt. The machine gives continuous delivery of material and is designed for both constant and variable belt speeds. Constant belt speed is best for operation at a fixed capacity and operations where the operator may change the scale poise setting to alter the feed rate. In variable-speed operation, the scale poise is not moved, and the feed rate is changed by adjusting belt speed. Capacity indicators are mounted adjacent to the speed controls; and the electrical tonnage totalizer and capacity indicator read directly in units of weight.

Three factors contribute to accuracy in the Waytrol. Note first that the fulcrum is at the opposite end of the weighbelt from the loading point. This results in maximum sensitivity of the scale system, with change in material delivery registering far better than if these two points were closer together. The effect of momentary underloading or overloading diminishes as the belt carries the material toward the fulcrum. This minimizes hunting or oscillation about the control

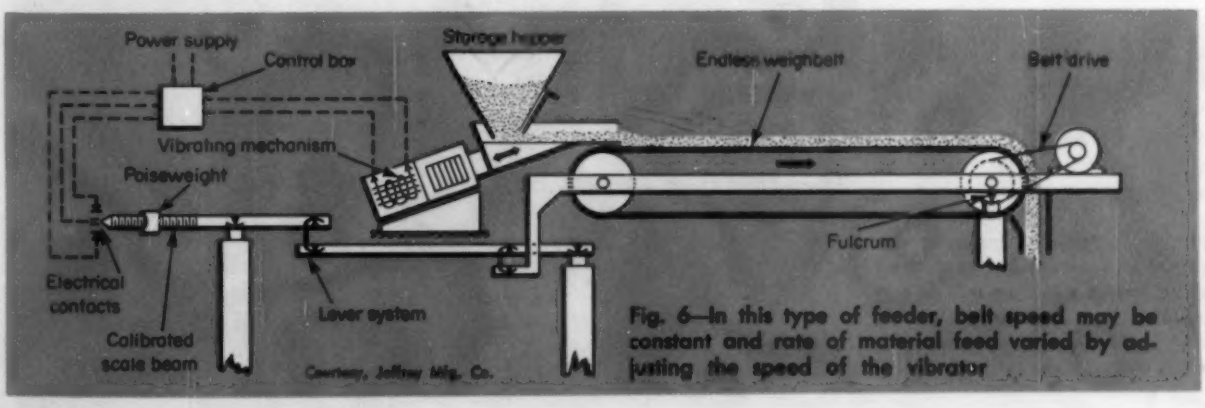
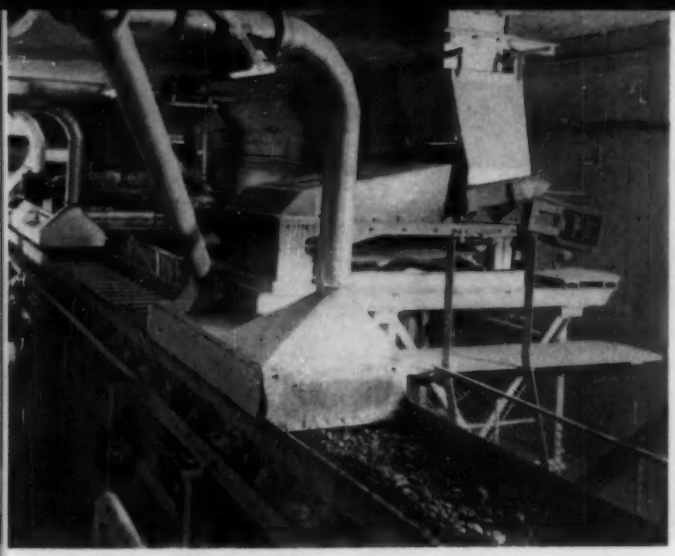


Fig. 6—In this type of feeder, belt speed may be constant and rate of material feed varied by adjusting the speed of the vibrator



Courtesy Jeffrey Mfg. Co.

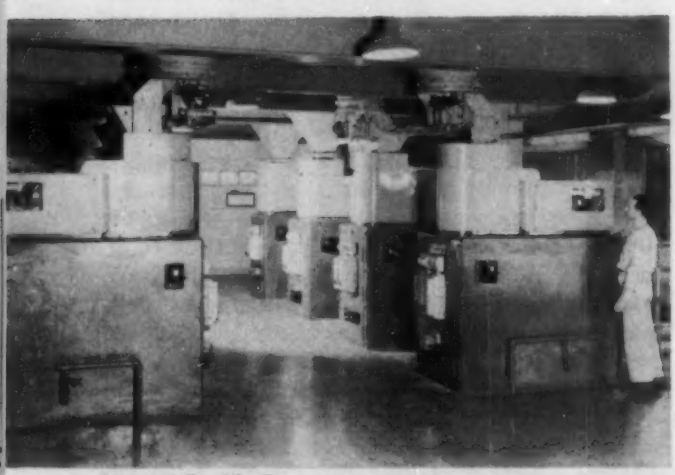
Fig. 7—Vibratory weight-controlled feeders can be used for a great variety of materials. The Jeffrey Waytrols shown here are feeding hot material to a metal apron conveyor

point. Second, the Waytrol scale has no mechanical functions other than weighing, and makes no gate adjustments. Third, there is no mechanical connection between the lever system and the material source. The lever system reacts mechanically, but the weighbeam transmits its movements via electric contacts, and thus the electric vibrating feeder operates without mechanical inertia or time lag. Tonnage indications are based on belt speed, not scale balance, and thus do not reveal feeding inaccuracies unless many different figures are integrated. The more uniform the belt loading, the less over-and-under error compensation is required. Waytrols are guaranteed to maintain desired feed rates with a maximum variation of plus or minus 1 per cent when belt speed is constant, based upon 10 minutes of continuous operation; and accuracy increases with longer operating periods. Applications of these feeders are illustrated in *Figs.* 7 through 10.

▶ Loss-in-weight Feeders

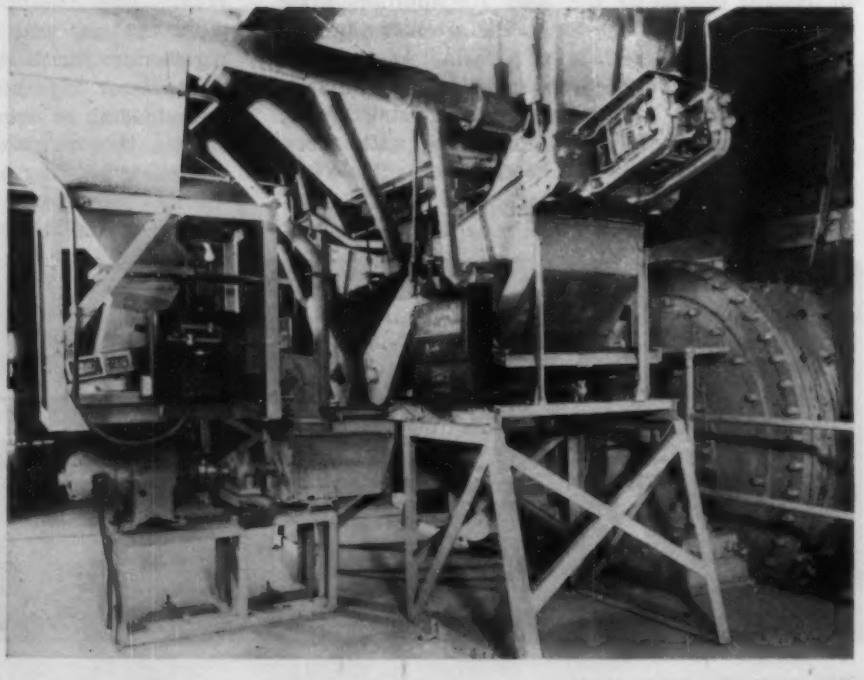
Basic components of loss-in-weight feeders are a feeding mechanism, a scale, a rate-of-feed controller, and recording totalizers. The Omega feeder, *Fig.* 11, is of this type, and combines mechanical control of the weighing mechanism with a vibrating feeder. The material hopper is connected to a scale lever system with a calibrated weighbeam. It differs from the usual system in that the poise does not move freely, but is mechanically retracted along the beam by a lead screw.

Before the start of a weighing run, but after the hopper is filled with material, the scale beam is balanced by manually adjusting the poise, and the desired rate of feed in pounds per hour is es-



Courtesy, Jeffrey Mfg. Co.

Fig. 8—This water purification plant uses eight vibratory weight-controlled feeders; some for chemical process control vital to public safety; others to monitor fuel consumption



Courtesy, Jeffrey Mfg. Co.

Fig. 9—Materials from three different sources are fed at desired rates into a grinding mill in this installation. The feeders are of the vibratory type similar to those illustrated in *Figs.* 6, 7 and 8

tablished in a rate setting device. Two motors are started, one to drive the feeding mechanism, and a synchronous motor which is driven by electric impulses from the rate setter. The second motor drives the lead screw, to which is geared a totalizer that indicates the weight of material discharged from the hopper. The lead screw also moves the poise of the scale beam at the precise rate that material is to leave the hopper. Thus the beam rises, thereby activating the vibrating mechanism; i.e., increasing the vibration and, consequently, the feed. Simultaneously, withdrawal of material lightens the hopper, imparting a downward force to the scale beam and causing the feeder to deliver less material. This illustrates the feed-then-weigh principle, with "remembered" data controlling over-under compensation of future loads. The Omega feeder insures accuracy within 1 per cent by weight, and within this tolerance the position of the traveling poise indicates the exact weight of material remaining in the hopper.

The operation of this controlled-weight feeder is entirely mechanical, with no electrical or electronic parts, and material feed adjusts without lag or overrun both to manual changes or those made automatically by proportioning devices. The wedge for controlling rate of feed is suspended from the weighing beam of the scale at the opposite end from the fulcrum. It is thus in the position of maximum sensitivity to load variation. The wedge hangs between the tapered jaws on the motor-driven oscillator and the feed tray, and the feed tray is vibrated by the oscillation transmitted through the wedge. Position of the wedge in relation to the jaws governs the amount of vibration transmitted to the feed tray. However, the momentary gripping of the wedge between the jaws does not impair the free movement of the scale beam.

Courtesy, Jeffrey Mfg. Co.

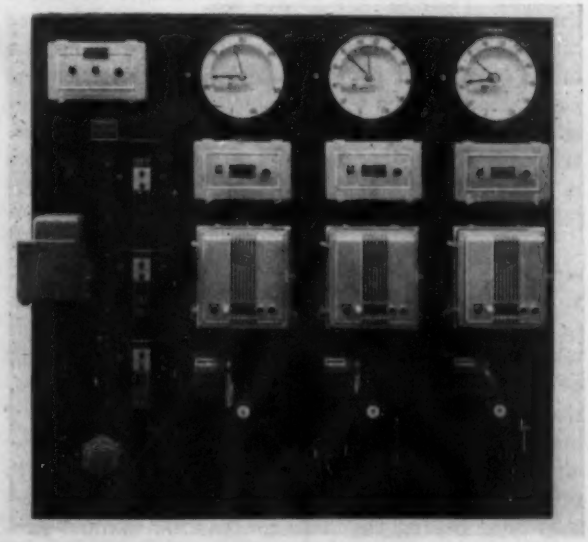
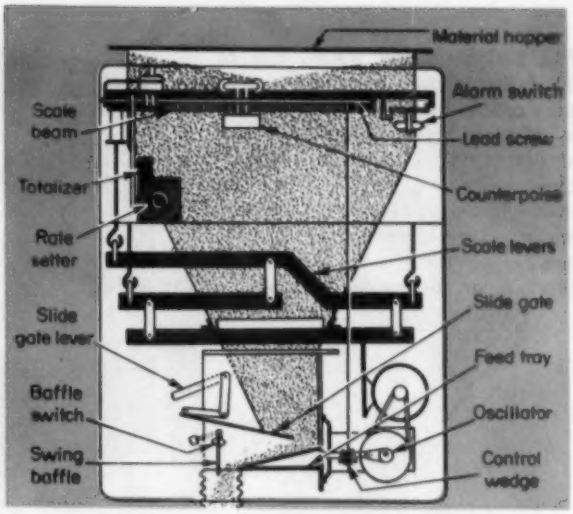


Fig. 10—Remote control panel for a system such as shown in *Fig.* 9. Feed rate from each source is controlled and individual feed rates and tonnage totals are shown



Courtesy, Omega Machine Co. Inc.

Fig. 11—Loss-in-weight feeders such as the Omega unit outlined here vary the oscillation rate of a feed tray to maintain a preset rate of decrease in weight of material remaining in a supply hopper

The usual variety of remote controls, recorders, and totalizers is available for these loss-in-weight feeders, and alarm systems can be provided. The totalizer is mechanically geared to the lead screw drive. Recorders may be either mechanically or electrically operated. If electric, it may be remotely located, and will show when the feeder is started and stopped; but it will not indicate the amount of material in the feeder hopper or when the hopper was filled. Electrical recorders can be linked to totalizers, with a 3-wire circuit between recorder and feeder and a power supply to the recorder.

The Omega Loss-in-Weight feeder can also be used for automatic proportional pacing. This is accomplished through such devices as a venturi tube with Chronoflo transmitter, or a meter with an electric contactor and time delay relay. The Chronoflo produces electrical signals, the duration of which is proportional to the rate of flow, and these signals control the lead screw motor. When used as a pacer, momentary contact is made after a predetermined amount of liquid has passed through the meter.

A complete survey of weight-control devices has not been given here, nor is this discussion intended to be advisory. Emphasis has been on processing rather than packaging operations, and only representatives of different types of mechanisms have been illustrated. Each model of the various types has its advantages and limitations; some having wider applicability than others. The manufacturers referred to here, as well as many others who supply such equipment, are the best final source of recommendations.

The author is indebted to the companies who assisted in furnishing engineering data and illustrations.

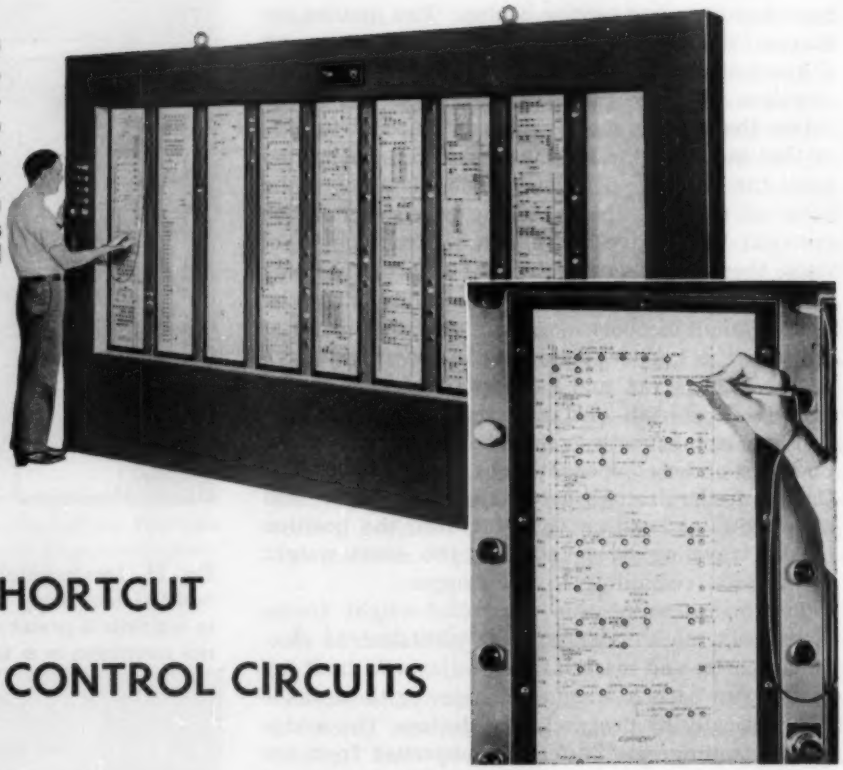


Fig. 1—Typical test panel, one of 15 designed and built for the complex control system of a large automotive plating machine. Closeup shows testing procedure. Electrician uses built-in probe to test terminal check points on diagram while power remains on. Defects are pinpointed in a small area and repairs can be made quickly

MAINTENANCE SHORTCUT FOR ELECTRICAL CONTROL CIRCUITS

MAINTENANCE is being discussed in automation circles as a growing area for emphasis. It has been pointed out that while direct labor in terms of operators is on the wane, indirect labor in terms of highly skilled maintenance teams is increasing. Upgrading of operators to technicians is offered as the school solution but obviously this is a long term project with many inherent personnel problems.

Any system or idea that can simplify maintenance both lessens the immediate problem and can provide for better utilization of maintenance personnel as their duties increase. The most time consuming effort, of course, is trouble shooting—particularly in electrical circuits.

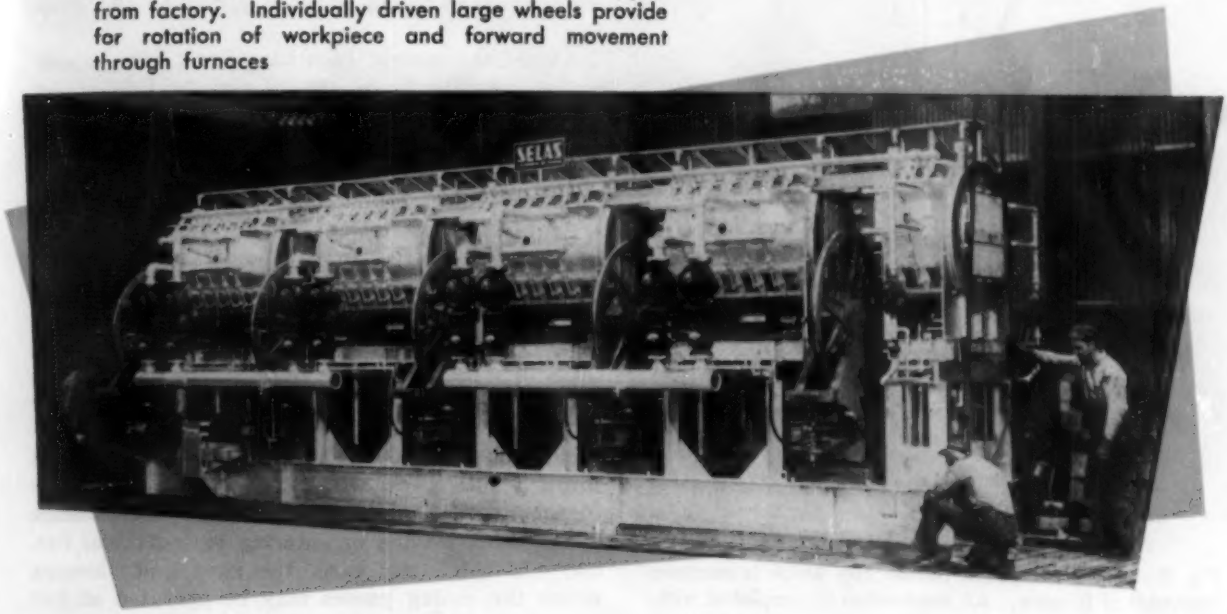
A wired-in checking system, an electrographic detector, *Fig.* 1, has been engineered to meet the current need for simplifying the maintenance and servicing of complex electrical controls by the Electrical Div. of W. F. & John Barnes Co. This development is a result of practical working experience in recognizing the maintenance problems of many types of special electrical controls for automatic production machines and equipment.

The system consists of separate electrical circuits wired to schematic electrical diagrams. It is designed to eliminate the delays and tedious checking normally employed to locate defects and failures in complex controls. The wired-in electrical diagrams, placed between sheets of transparent plastic and mounted in separate illuminated panels, are equipped with terminal check points and sequence-indicating lights which enable the plant electrician to locate failures in the control system. Each of these terminals represents a connection between two contacts in the electrical control. A grounded test probe inserted in the terminal check points, provides a means for determining the exact location of any defect in the electrical control circuit. The series of lights located adjacent to the diagram indicate the progressive operation of the equipment through its entire cycle so that any stoppage or malfunction is readily apparent.

When aided by a detector system it is not necessary for the electrician to be familiar with the sequence of operation of the machine or to check through the entire electrical circuit. Troubles are pin-pointed in a small area so that repairs can be made quickly in that localized area. Another important advantage is the ability to test for trouble while the power is on, since the maintenance electrician need not enter the control cabinet. This is particularly helpful when hard-to-trace, intermittent failures occur.

This system is engineered for use with unitized electrical control systems of step-type design. However, it is also possible with certain modifications to adapt this system to electrical controls which are not step-type. In such cases, an analysis of the wiring diagram and the sequence of operation of the equipment is required to determine if modifications can be made economically. If the circuits are not adaptable, it may be necessary to provide a complete new control system of the step-type before the detector can be applied profitably. Thus this system meets the demand for greater simplification of complex controls which helps to reverse the trend toward increased load on maintenance and plant-operating engineers.

Fig. 1—Complete unit of five barrel furnaces as shipped from factory. Individually driven large wheels provide for rotation of workpiece and forward movement through furnaces



SHORT-CYCLE HEAT TREATMENT

CONTINUOUS PRODUCTION SAVES ALLOYS AND TIME

By JAMES KNIVETON
Vice President
Selas Corp. of America
Philadelphia, Pa.

Specialized gas furnace design incorporating an instantaneous and efficient control of combustion provides for continuous heat treatment in the manufacture of high-strength pipe

CONVENTIONAL heat and draw cycle for batch production of high-strength oil well casing from high-alloy steel takes at least 12 hours. An equally strong casing of low-alloy steel can be processed in only ten minutes by a short-quench and draw operation. The difference in processing time between the two operations is considerable—but is typical of the major forward strides taking place in industry when production techniques keep abreast of technological know-how.

Conveyorized Furnace

Key equipment in advancing short-cycle heat treating is a cylindrical gas-fired furnace developed by the Selas Corp. of America. A typical furnace is four to six feet in length with a chamber diameter only slightly greater than the largest diameter of casing to be processsed.

In operation, a number of these barrel furnace units are lined up, with conveyor rollers between the units, to form a single, conveyorized furnace installation. Small, concave rollers, with their axes almost perpendicular to the line of pipe travel, were used originally in the conveyors. While this type of roller is still used, more recent evidence of the value of high rates of rotation of the workpiece has led to the use of a pair of large-diameter wheels turning on axes almost parallel to the line of pipe travel through the furnaces. Forward motion of the pipe is effected by skewing the axes of rotation by as much as 15 degrees.

With either type of conveyor, each roller or pair of wheels is turned by an individual electric motor. The entire conveying unit is mounted outside of the furnace away from the higher temperatures therefore special temperature-resistance alloys are needed only for those components actually in contact with hot pipe. This type of installa-

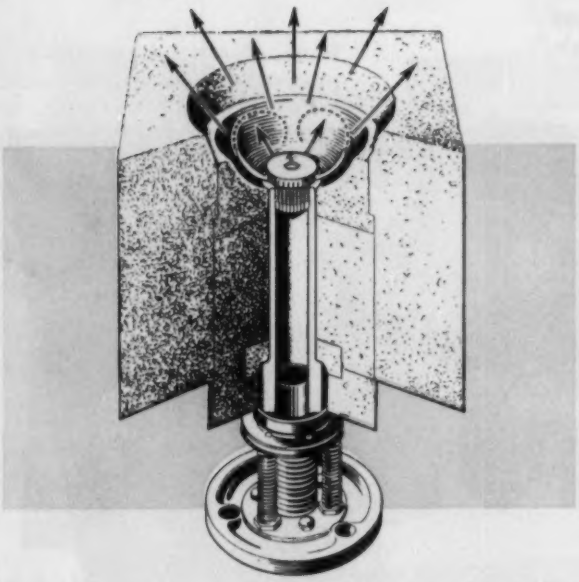


Fig. 2—Details of special burner cup which is recessed into wall of furnace. All combustion is completed within cup; workpiece is heated by radiation and by convection of nonoxidizing combustion products

tion greatly reduces wear and simplifies both maintenance and control.

The barrel furnace design simplifies the problem of installation. All refractory materials are installed at the factory. Units consisting of several furnaces, permanently mounted with all conveying equipment on an integral structural framework, are shipped ready for operation, *Fig.* 1. At the mill, the unit need only be set in place, and control and feed lines attached.

Heat transfer is primarily a function of temperature and time. In the gas fired barrel furnaces, uniform, high-speed heating is accomplished by establishing a high gradient, or temperature difference, between workpiece and radiant cup burners set into the inner wall of the furnace. A very rapid transfer of heat takes place by a combination of radiation and convection.

Combination controllers accurately proportion gas and air, and feed the mixture under pressure to the recessed "Duradiant" burner cups, *Fig.* 2. This pressure and proportioning remain constant even when individual burners or whole furnace units are turned down or completely shut off. No flame comes in contact with the pipe because of the complete combustion and a protective atmosphere of combustion products, which extends across the short interval separating furnaces, prevents scale formation on the tubing being processed.

▶ Control Features

The barrel furnace design lends itself to a wide range of mechanical and thermal control. Conveying units are extremely flexible since they operate in the cooler space between units, with controlled variation possible in forward speed of the tube, *Fig.* 3.

As to heat control, each barrel unit may be controlled individually or several may be fired under a single control to form a heating zone. Burner groups can be turned down over a range of 15 to 1 and burners or whole units can be completely shut off while the line is in operation.

An increase or reduction in the flow of the fuel mixture results in an immediate corresponding change in radiation from the burner cup, thus, it is possible for controls to provide for a high heat output only when the tubing is actually passing through a furnace. At other times, the furnace is idled for fuel economy and longer refractory life. Control of the high heat level may be obtained by a preset time-temperature cycle or through automatic feedback circuits providing for furnace operation according to the temperature of the stock leaving or entering an individual furnace. In the latter case, the first unit through which the casing passes may be operated at full capacity, while later furnaces in the line are automatically adjusted to provide only the amount of heat required to reach and to hold the desired temperature.

Maximum protection for workpiece and furnace is provided by a high limit control. A radiation detector sights on the closed bottom of a tube extending into the furnace cavity. Suitable solenoid valves actuated by the detector cause a furnace. In the latter case, the first unit through fire, reduce available air and finally to cut off the supply of gas as successive steps in attempting to reduce the temperature if a specified high limit is exceeded.

Typical details of these various control features are shown in *Fig.* 4. Photoelectric cells provide for the idling control. When a light beam is not interrupted by a workpiece, the cell actuates three-way solenoid valves which reduce fuel supply to idle by closing diaphragm master valves, leaving only a bleed-line supplying fuel mixture. When the light beam is interrupted by a workpiece, the temperature recording controller takes over control of the individual furnace.

The segmented structure of the furnace installation permits unusually accurate determination of work temperature as the radiation pyrometers are mounted outside of the furnace where they will be least affected by radiation from furnace walls, gases, and other sources. Since the short-cycle heat treatment leaves the stock shiny and relatively scale-free, this is a fairly dependable technique.

By means of the diaphragm motor valve, fuel supply is controlled by the recording temperature controller in accordance with a sensing of the radiation pyrometers compared to a manually adjustable set point. As indicated in the diagram, the high-limit temperature control can protect more than one furnace. When actuated it overrides both temperature controllers as has been previously indicated.

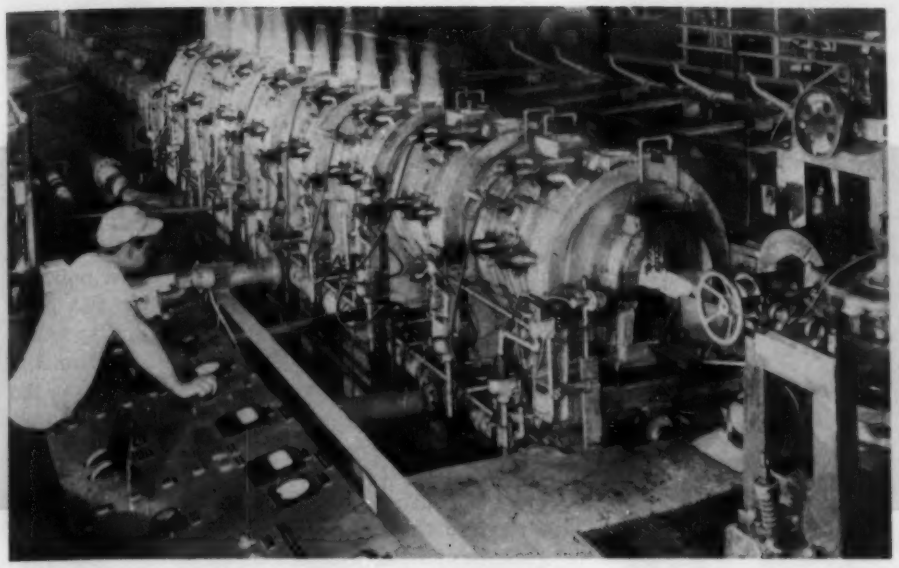


Fig. 3—Seamless tubing being heated prior to straightening operation. Operator at console controls movement of pipe. Rear furnaces are operating at high pressure and front furnaces at near idling as shown by "stingers" of combustion products issuing from flues

Seamless Pipe Production

Selas furnace lines had been used previously on many types of bar and tube stock, but the first continuous line for hardening and tempering oil-well casing has been in operation only since 1947 at the Ambridge, Pa., plant of Spang-Chalfant division of the National Supply Co., *Fig.* 5. Here 30 to 50-ft lengths of pipe are sent through a line of six barrel furnace units and a high-pressure water spray, or quench, at speeds that range from 3¼ to 6½ fpm. One end of a length of pipe will normally be entering the quench ring just as the other end enters the first furnace unit. The pipe reaches 1600F before it enters the quench spray, which quickly brings the temperature to about 125F.

A conveyor table moves the pipe laterally after it leaves the quench head, empties the pipe of any water that may be inside, and feeds the pipe into a draw furnace line running parallel to the quench line, at the same speed and in the same direction. In the draw line, the pipe is raised to about 1125F in six barrel units, and then is discharged to cool slowly in the air.

This installation produces from 4.8 to 5.4 tons of quenched and drawn pipe per hour, ranging in size from 5½ inches OD by 0.304 inches wall to 9⅝ inches OD by 0.435 inches wall. The quench and draw line occupies 5850 square feet, with combustion controllers and temperature control instruments occupying a separate room of 1400 square feet. Two men operate the line, making all necessary changes for different sizes of pipe, checking the automatic functions, loading pipe on the charging table, and baling processed pipe on the discharge table.

In a similar installation at the Pueblo, Colorado, mill of Colorado Fuel & Iron Co., the draw line runs in the direction opposite to that of the quench line, in a U-shaped arrangement, *Fig.* 6. This installation, which has only recently begun production of high-strength oil well casing, contains eight barrel units in each section.

One reason for having the quench line and the draw line separated laterally is to allow for a mechanism to remove any water which may enter the tubing as it leaves the quench spray. However, in an automatic heat, quench and draw line recently constructed by Selas for another large steel mill the hardening and tempering sections

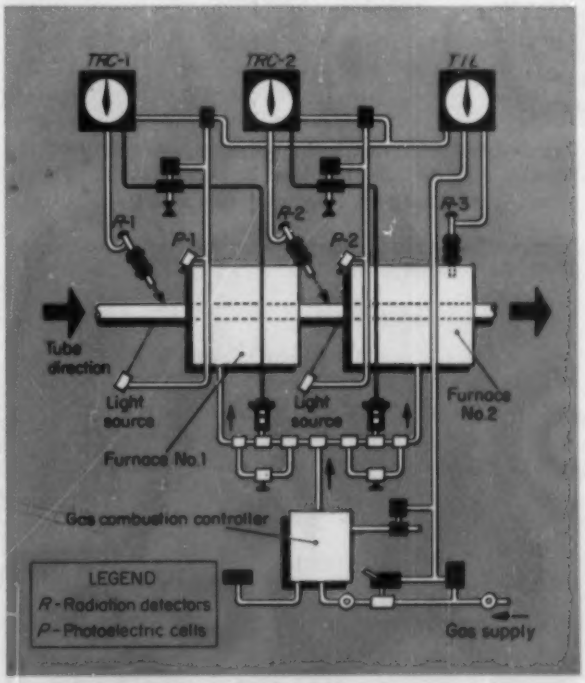


Fig. 4—Details of automatic control system of furnaces. Individual temperature controllers are provided for each furnace. High-limit control is provided for one or more furnaces

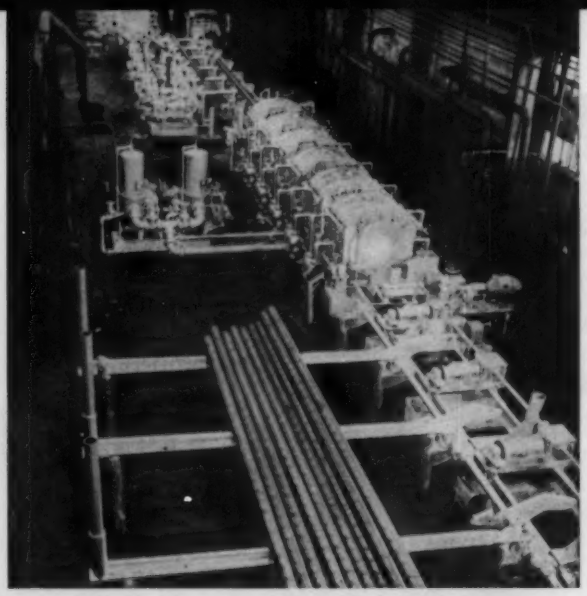


Fig. 5—Short-cycle heat treatment line at the Spang-Chalfant Div. of National Supply Co. Charging table is at bottom. Offset in line of furnaces provides for mechanism to remove water from pipe after quenching at end of first furnace group

are placed in the same line. This simplified handling between quench and draw is made possible by successful control of water entering the pipe. Another innovation in this latest installation is the use of a conical spray guard downstream from the quench head to hold the quench water close to the tubing for increased quenching efficiency, *Fig.* 7.

In addition to these installations producing seamless pipe, improvement in the quality of welded pipe has led to its increasing use in the oil industry, in competition with seamless tubing. Continuous, short-cycle normalizing, a close counterpart to the short-cycle quench and draw process, has played an important part in this development.

As an example, at the Lone Star, Texas, mill of the Lone Star Steel Co. each of two Selas normalizing lines consists of a charge table, 33 barrel furnace units, and a discharge table. The furnaces are similar to those used in the quench and draw lines, except that gas and air are brought to each burner in separate lines and mixed in specially designed nozzles. A unique feature of this mill is the lack of manual handling of the pipe from the initial coiled strip steel through cold forming, welding, cutting into lengths and normalizing. The entire cycle is completely automatic.

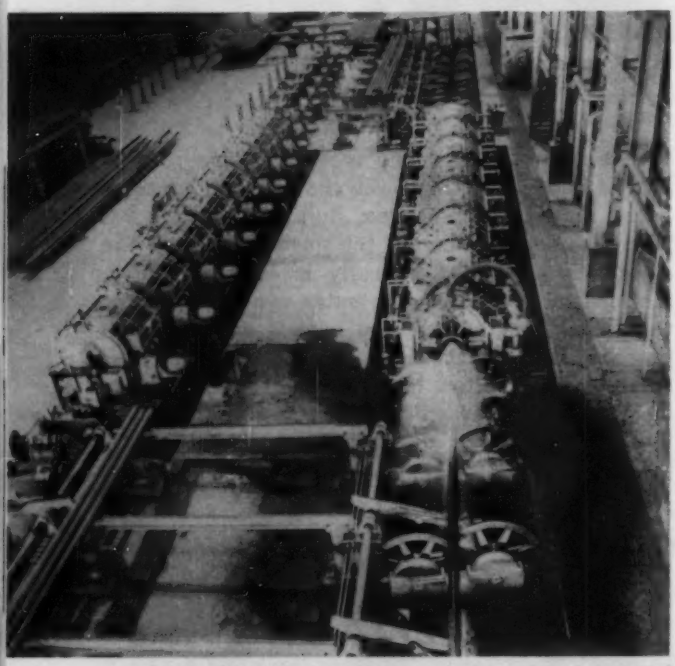


Fig. 6—Hardening and tempering furnaces are arranged side by side at Colorado Fuel & Iron Co. mill. Picture shows pipe emerging from quenching ring

In Summary

Since the introduction of short-cycle heat treating less than a decade ago, manufacture of low-alloy casing with a yield strength of 80,000 psi has become commonplace. Prior to that time, a normalized and drawn, high manganese, molybdenum steel was considered necessary in the manufacture of casing to meet this yield strength requirement. The conservation of considerable quantities of critical alloying elements is important but it so happens that the low-alloy steel pipe is no mere substitute; it has proved better than the original product in several important respects. It is more easily machined than casing made by the older method and promises to make practical the quantity production of casing for extremely deep wells. Yield strengths of 110,000 psi and higher, suitable for these depths, have already been obtained with the short-cycle heat treatment.

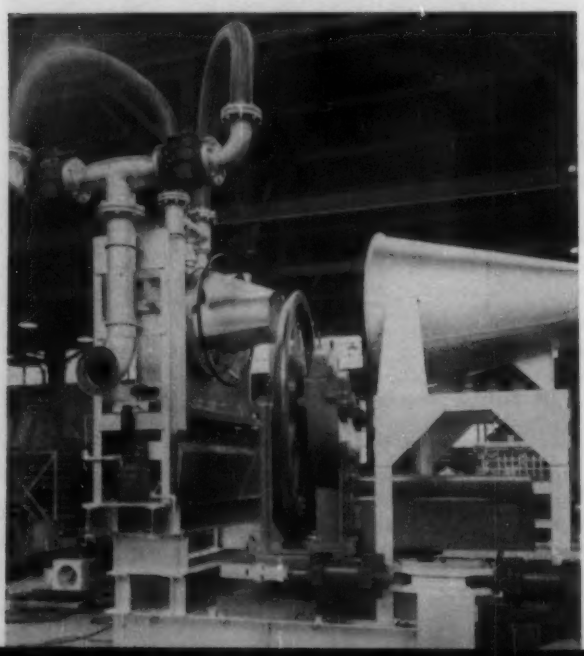


Fig. 7—Latest development in quench rings provides conical spray guard downstream from quench head to hold quench water close to tubing. Hydraulic cylinders change angle of driving wheel to vary rate of travel of the workpiece

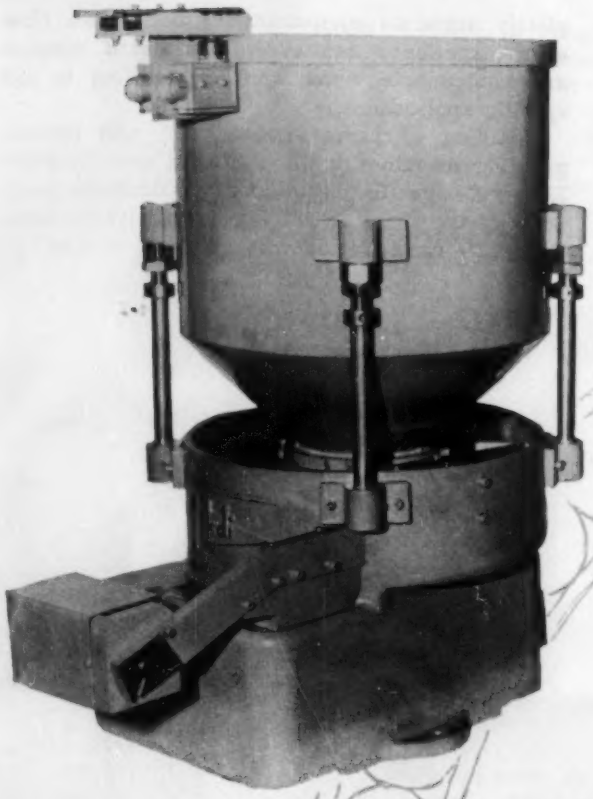


Fig. 1—Hopper feeder equipped with limit switches controlling supply to the hopper accumulator by turning a supply conveyor on and off. The air operated "inserter" on the outlet chute of the feeder is controlled and timed by the grinder dial into which it feeds the parts. For through-feed operations this same equipment without the inserter can be used

PARTS HANDLING-

KEY TO GRINDER AUTOMATION

By REX STEVENSON
Vice President, Sales
Kraus Design Inc.
Rochester, N. Y.

Fig. 2—Rotation about a horizontal axis feeds parts from this unit in a range of lengths and diameters. The hopper feeder shown was designed to feed trunnion rollers to a centerless grinding operation

INTEGRATED PRODUCTION LINES are symbols of modern manufacturing methods. Such lines can be composed of special purpose machines, but more plants find it profitable to use standard machines with suitable attachments and handling devices. Grinding is one of the fields where auxiliary equipment is often used to link standard machines for automated operation. Units for end, centerless, race and bore grinding combined with auxiliary equipment such as hoppers, parts elevators, gages and feedback controls, chuting, timers, etc., can form a completely automatic line.

Wherever they can be used, standard attachments and handling devices offer many advantages in the integration of individual machines into continuous production lines. Because of the numerous types of grinders and the almost limitless variety of piece parts to be ground, no com-

pletely universal equipment has been built. However, experience has evolved standard methods and components which can be modified to suit specific applications.

Handling of parts into, out of, and between grinding machines is an industrial area in which Kraus Design Inc. has done considerable work. Some of the types of equipment and layouts which they have used are illustrated in this feature.

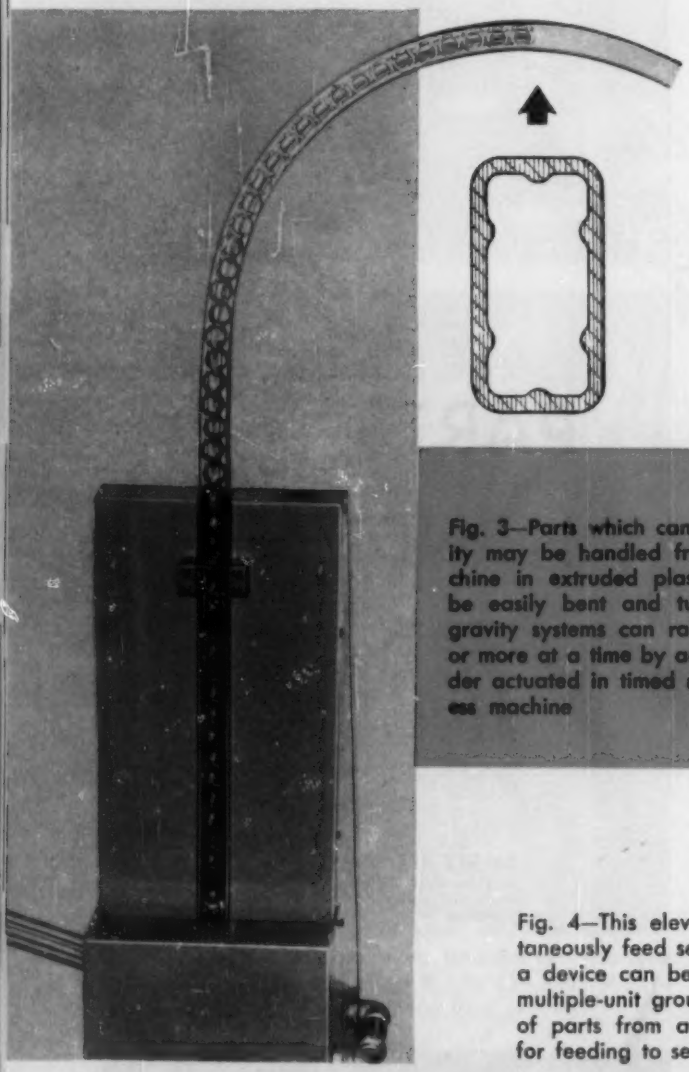


Fig. 3—Parts which can be rolled by gravity may be handled from machine to machine in extruded plastic chutes that can be easily bent and turned. Elevators in gravity systems can raise parts either one or more at a time by action of an air cylinder actuated in timed relation to the process machine

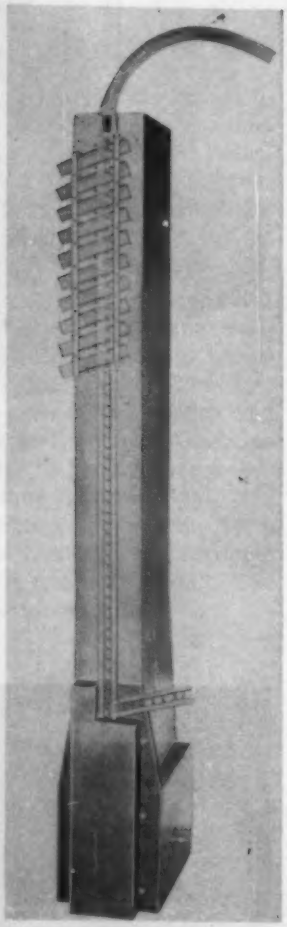
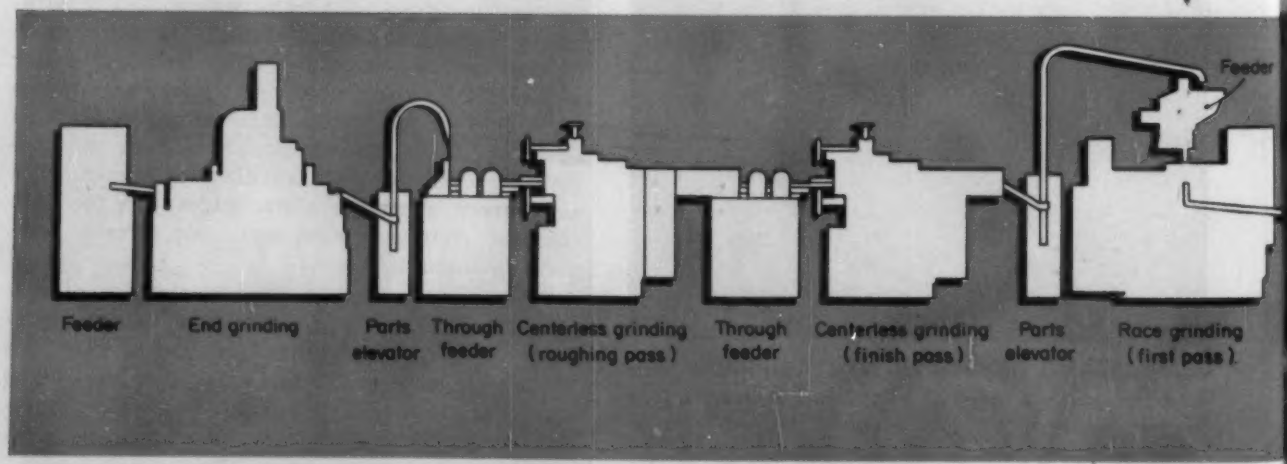


Fig. 4—This elevator is designed to simultaneously feed several gravity chutes. Such a device can be used to arrange parts in multiple-unit groups or to break down flow of parts from a high production machine for feeding to several slower machines



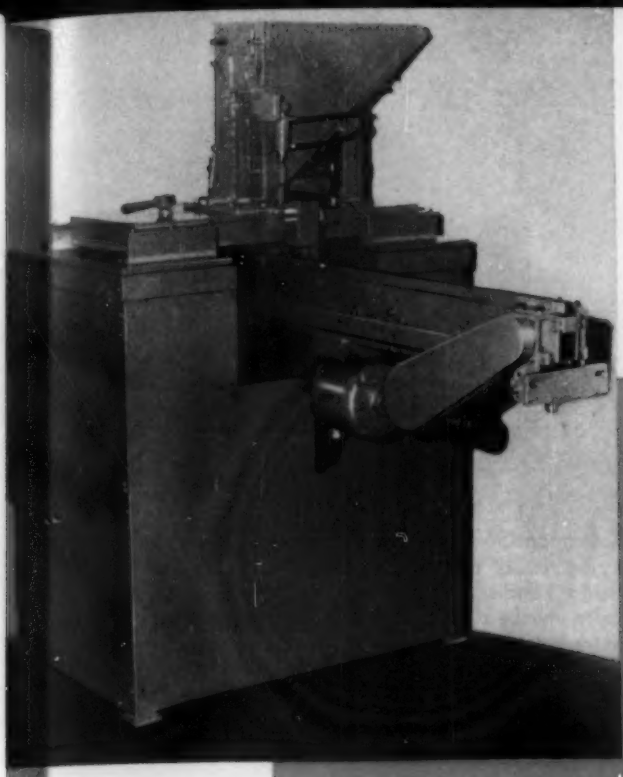


Fig. 5—This hopper and conveyor unit is useful in feeding shafts into a grinder. Parts are fed in while perpendicular alignment with the workrest is maintained by specially designed guards regardless of grinder wheel wear. Where alignment is not too important, as in a rough polishing operation, shafts may be fed from the hopper and into the machine by force feed wheels, with an air cylinder to start the shafts into the feed wheels

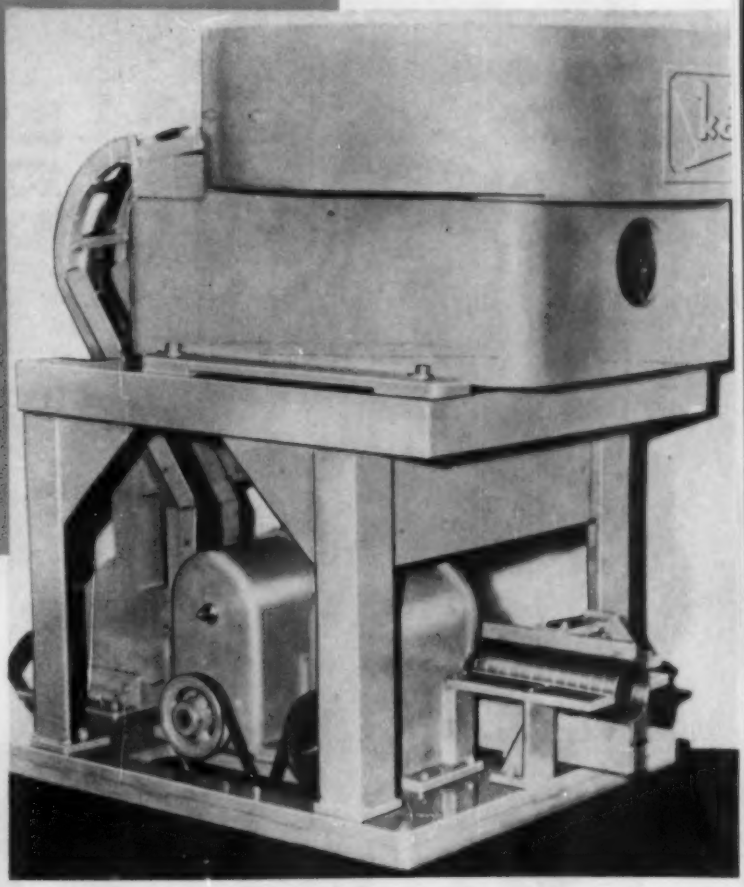


Fig. 6—Bearing races are fed from the hopper of this feeder with their axes parallel and vertical. The chute carries them down to a stacking device which orients the races so their axes are aligned. Two pairs of variable speed feed wheels force parts through the grinder at the desired feed rate

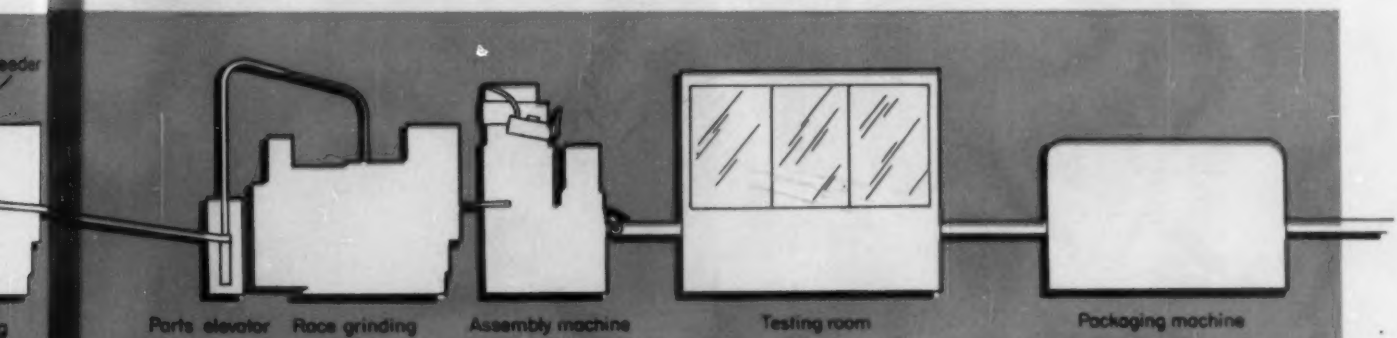


Fig. 7—Schematic drawing of a possible integrated bearing production facility. Automatic handling, inspection and control devices unite the standard and special machines in the line

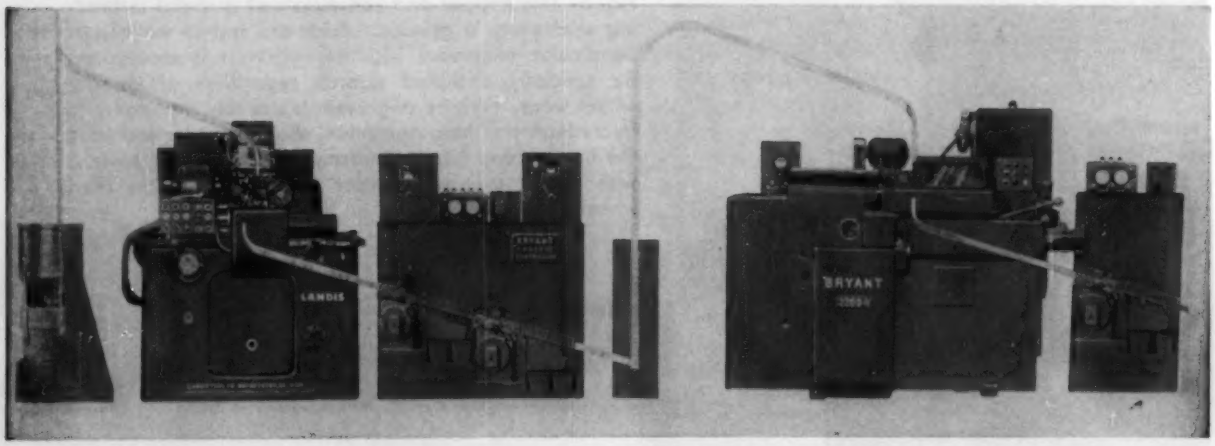


Fig. 8—Illustration of an actual portion of an integrated line. Bearing races are fed from a K.D.I. hopper and elevator to a Landis No. 4 concentric grinder, and are automatically checked by a Federal gaging unit connected to a Bryant process controller which adjusts settings of the grinder. A second elevator then feeds the races to a 2209-Y Bryant for bore grinding, with size again automatically controlled

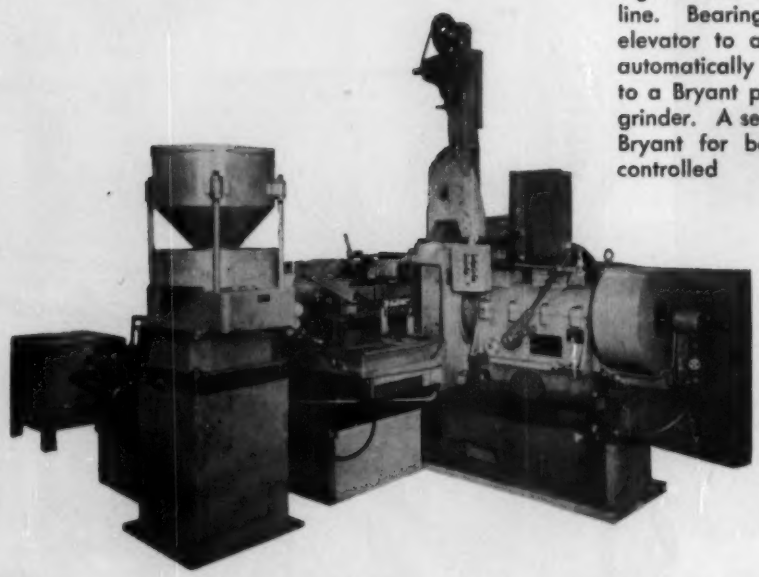


Fig. 9—Various sizes of steel slugs are ground on this Besley 30-inch No. 226 equipped with a chain feed. The hopper unit automatically loads the chain and a limit switch energizes a red light when the part supply is low. Slugs 1½-inch diameter by 0.350-inch thick are ground at the rate of 13,350 pieces per hour

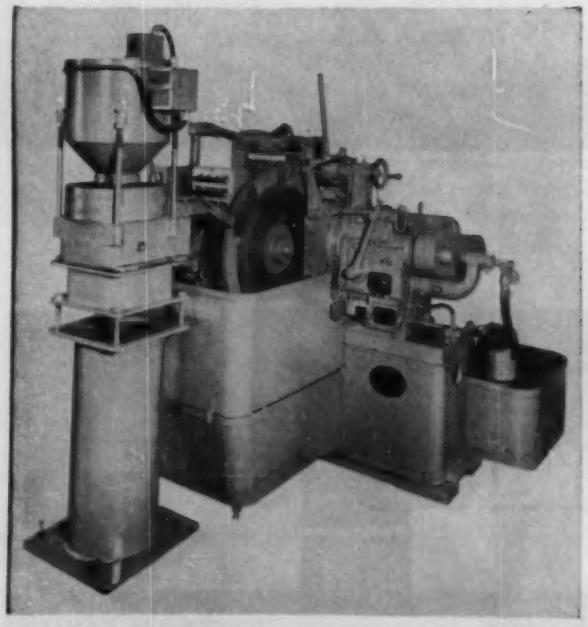


Fig. 10—In another installation with warning signal for low part supply, the hopper feeds speedometer drive pinions onto the rotary feed wheel of an 18-inch Besley No. 212 double spindle grinder at the rate of 1000 pieces per hour

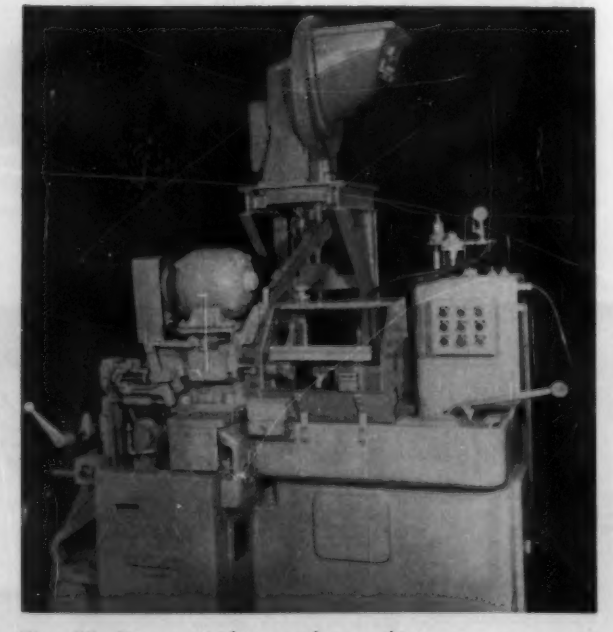


Fig. 11—Race grinders such as this Bryant 2209-D are usually built for automatic loading through a stub chute. It is a simple matter to add a feeder as shown here

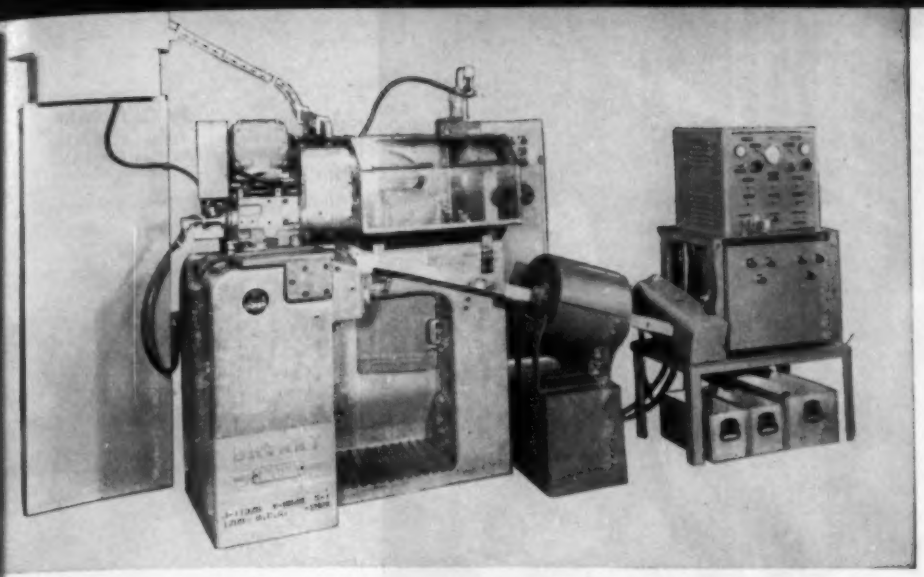


Fig. 12—Parts fed from the hopper to this internal race grinder are checked for size by a Moore air gage, and through a Bryant process controller the grinder settings for desired mean dimensions are automatically maintained

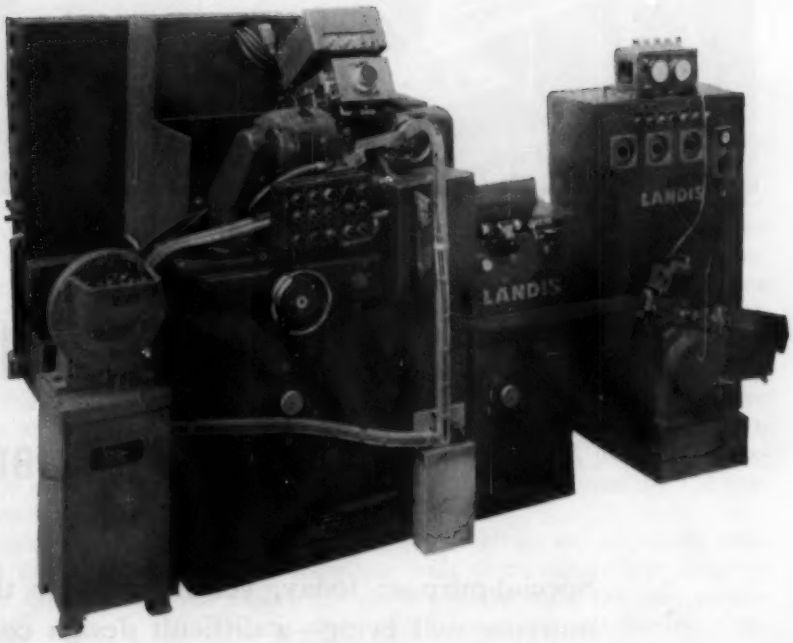


Fig. 13—In this operation the hopper feeder is placed at a low elevation for operator convenience, and an elevator is needed to feed races into the Landis grinder. Parts are automatically ground, ejected and inspected, and the grinder is automatically adjusted to maintain required dimensions

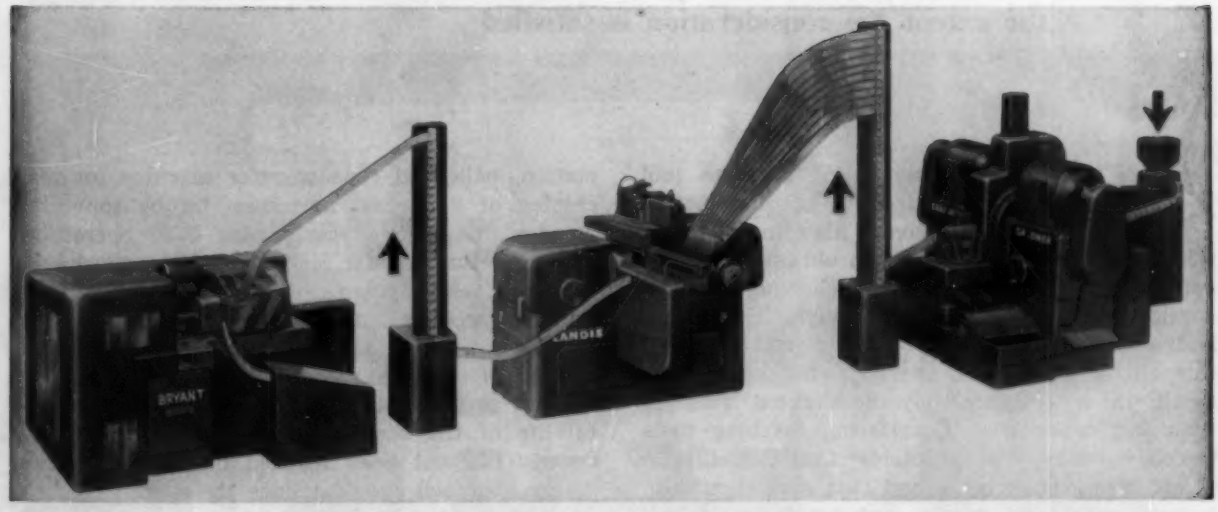
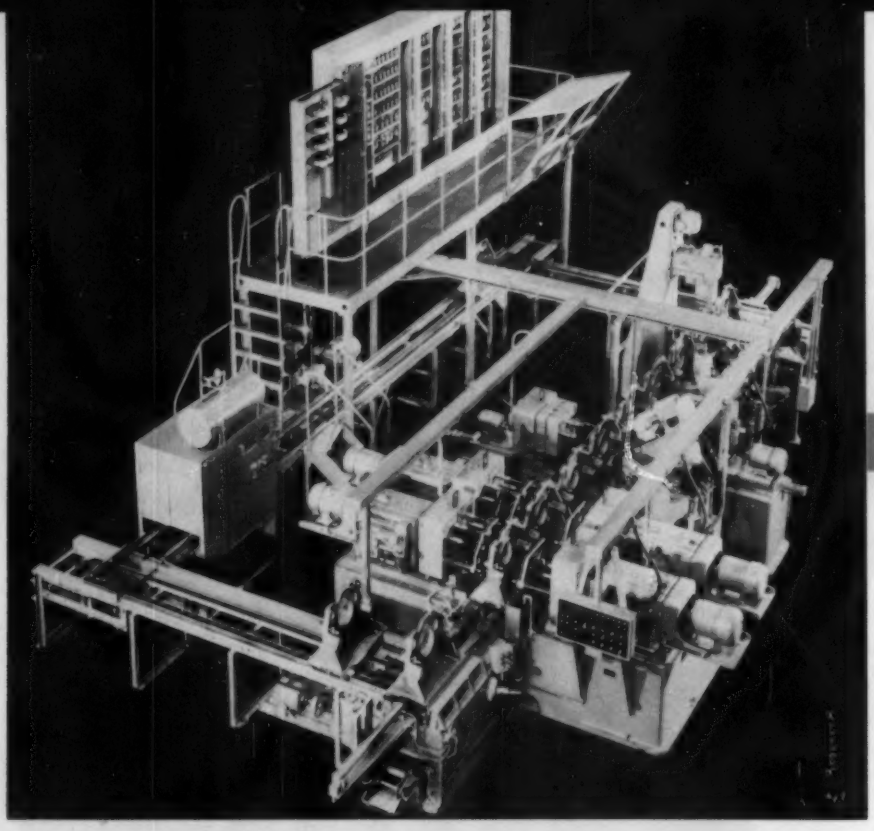


Fig. 14—In a more elaborate production line, a K.D.I. hopper feeds races into a Gardner end grinder which ejects the piece parts into an elevator that raises and diverts them into 10 chutes to feed the Landis O.D. grinder. Following that operation the parts are again elevated and roll by chute into the Bryant ball race grinder



By C. P. FARR
Technical Director
Modern Tool Works Ltd.
Toronto, Canada

Fig. 1—Overall view of transfer machine designed by Modern Tool Works Ltd. From load station in lower part of picture, part progresses through 12 work stations and by return conveyors through pneumatic chip removal station to starting point

TRANSFER MACHINE

AIMS FOR FLEXIBILITY

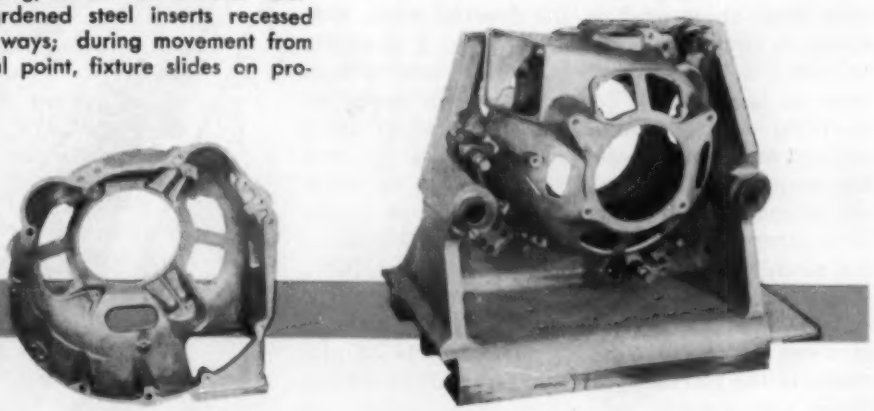
Special-purpose today, yet flexible for the changes which tomorrow will bring—a difficult design consideration to satisfy. The value of an expensive machine tool is enhanced, though, to the extent the consideration is satisfied

WHATEVER one thinks of machine tool automation as practiced in the automotive industry, in comparison to his own particular situation and needs, there is an almost unequaled opportunity to learn by closely following industry developments. For as the adage says, "Experience is the best of schoolmasters . . ." and a highly competitive market and yearly model changeovers result in a comparatively accelerated rate of acquiring experience. Considering machine tools in this industry, it is of interest that flexibility is of increasing importance and that special-purpose transfer machines are not excluded from this renewed emphasis on flexibility.

As a case in point, Modern Tool Works Ltd. has responded to this interest in the design of a 12-station, palletized type transfer machine for machining of a die-cast aluminum torque converter housing. Capable of performing 5520 operations per hour, the transfer machine is of unitized construction, embodying a degree of flexibility in order to accommodate future component changes or retooling to suit a different component. Through the use of standardized elements, additional work stations may be added to further extend the useful life of the basic machine. The ultimate definitely has not been reached but, in time, this design approach should reduce the special content of such machines to a point where the tooling will be the only special portion.

The main body of the Modern Tool Works transfer machine is made up of three principal

Fig. 2—Die cast aluminum housing, on and off fixture. During machining operations, hardened steel inserts recessed into bottom of fixture contact ways; during movement from last machining station to initial point, fixture slides on projecting legs of base



sections which provide two working positions for the fixtures, a corner section at the load end, and a corner section at the discharge end, *Fig.* 1. An idle station is provided between each of the sections to permit unitized construction and to provide ample space between units for tool change and set-up. Fixtures are automatically returned from the discharge end to the load station by three synchronized conveyor sections. Twelve machine units, mounted on suitable wings, are arranged about the three principal sections in the correct position required to perform the various machining operations.

The work holding fixtures hold the torque converter housing in an upright position, *Fig.* 2. When the part arrives at the machine, the engine face has been machined and it is on this face that the component is located. Pins position the component in the fixture and the part is clamped at three points with screw-type clamps arranged to prevent distortion. The underside of the fixture that comes in contact with the ways is faced with hardened steel inserts to resist wear.

Fixtures are moved hydraulically from one position to another on hardened dovetail ways by means of a sectional transfer bar running the length of the machine. The transfer bar rotates at the end of its stroke in order to return to await the next transfer. The fixtures are located at each position by a series of shot bolts which are elevated and lowered by a sectional cam bar running under all work positions along the machine and powered by a hydraulic cylinder. The means by which the transfer bar picks up the fixtures and the sequencing of the transfer bar and cam bar motions are such that the fixtures are under positive control at all times. When located by the shot bolts, the fixtures are clamped on the ways by the action of a hydraulic cylinder forcing a short section of way to swing out, locking the fixture in position. Operations performed by the machine are shown in *Fig.* 3.

The return conveyor sections are all driven from one motor-reducer unit featuring a fluid coupling to absorb the shock created when the lugs on the conveyor chain pick up a stationary fixture. Dur-

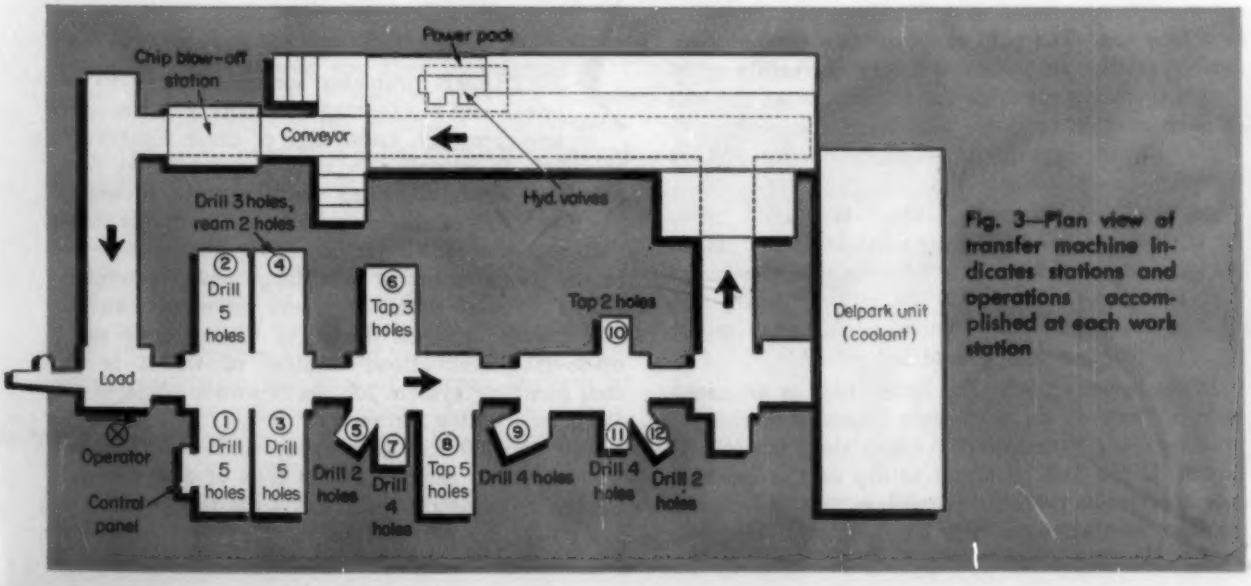


Fig. 3—Plan view of transfer machine indicates stations and operations accomplished at each work station

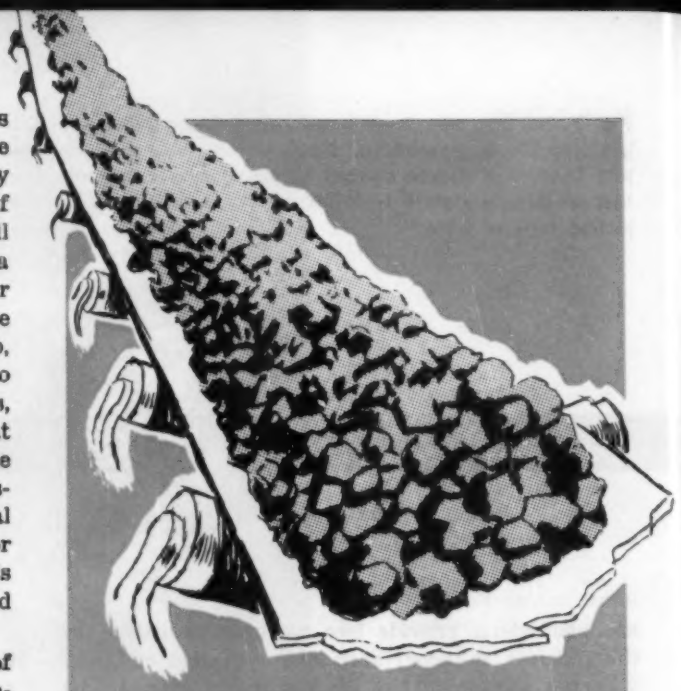
ing the return cycle the fixtures, on surfaces other than those used on the dovetail ways, slide along on composition strips providing a relatively friction-free motion and causing a minimum of wear on the fixture. To conserve floor space, all electrical control equipment is contained in a cabinet on a mezzanine directly above the rear conveyor section and is so arranged as to locate all equipment pertaining to a unit in a group, facilitating service to the equipment. Wiring to the machine is contained in overhead steel ducts, supported on steel posts. Ducts are jointed at suitable intervals and have terminal strips inside at these points to simplify the problem of dismantling the machine for shipping. These terminal strips also provide convenient check points for trouble shooting. The top side of all ducts is formed by a cover which can easily be removed for service.

Electric interlock is provided to all motions of the machine to insure safe operation. The control panel at the load station contains a signal light system to indicate to the operator the position of all units, transfer bar, shot bolts, clamps, conveyor, etc. This provides a fast method of identifying an individual device which fails to complete a motion.

With the exception of four self-contained hydraulic feed units, hydraulic power for the entire machine is supplied by a power pack located beside the rear section of the conveyor. All piping, to and from the various points in the machine, is suspended below the overhead electrical ducts for ease of maintenance and alteration. Valves in the hydraulic circuit are all located in a cabinet on the end of the mezzanine beside the electrical cabinet and directly above the power pack. Coolant at each tool is piped into a manifold in the retracting bush plate, which provides a separate outlet tube for each cutting tool. Coolant and chips drop into the main sections of the machine onto a drag type conveyor which runs under the entire machine and delivers the coolant and chips to a special unit where the coolant is filtered and returned to the sump and the chips are deposited in a tote box. The chip conveyor is a complete assembly resting on rollers and may be readily withdrawn from the machine for servicing. At the end of each machining cycle, a solenoid-operated valve shuts off the supply of coolant during fixture transfer.

On the rear conveyor section is a chip blow-off station. A loaded fixture containing a finished part is stopped inside this housing where a manifold of air jets blasts off the chips. During the next cycle, the cleaned fixture is delivered to the operator for unloading and reloading.

In its present form, the entire unit is an excellent example of an up-to-date transfer machine—it is compact, maintainable and it does the job required of it. The potential utility of the machine has been enhanced by providing that future expansion and changes will be facilitated by prior design considerations.



INTEGRATED CONVEYOR SYSTEM

STORES AND FEEDS COAL

EXTREME problems sometimes lead to extreme and fascinating solutions. For the average company, knowledge of these remarkable solutions is valuable in that the future is foretold and, often, solutions are suggested to scaled-down versions of similar problems. Enormous power requirements of Atomic Energy projects have led to the development of new, large power producing plants. Power plant engineers have been able to incorporate into the design of these plants many up-to-date innovations—typical of which is the coal handling system for the Shawnee plant of the Tennessee Valley Authority.

Ten 150,000 kw generating units of this new power station require 14,000 tons of coal per day. Design engineers were faced with the problem of tying together into an integrated system the following scattered points: A barge unload point; rail-

Fig. 1—Aerial view of power plant indicates extent of coal conveyor system. Coal is received by barges and railway (right rear). Stockpile, shown at right, is connected into system by underground conveyors

way car unload point; a crusher; a 1,450,000 ton stockpile; and, in the power plant itself, ten hoppers which receive crushed coal prior to a pulverizing operation, *Fig.* 1. The solution involves nearly three miles of rubber conveyor belts, furnished by the B. F. Goodrich Co., and a central electric control station.

The central control point is located atop the crusher building, *Fig.* 2, a focal point for the conveyor system composed of 10 sections. One section, 2640 feet long, extends to the barge unload point where over half the coal received at the plant is unloaded. Coal is deposited by a crane into a receiving hopper and then transferred by a short 260-foot conveyor section onto the longer section for delivery to the crusher. This river-to-plant belt is enclosed by a metal housing supported by towers 50 feet above the ground.

Coal received by rail on the other side of the plant is introduced into the conveyor system at a rotary car dumper located approximately 700 feet from the crusher. If destined for immediate plant use, crushed coal is carried by twin conveyor belts from the lower part of the crusher up a 16-degree incline to the level of storage bunkers at the top of the generating plant. Capable of handling 700 tons per hour, the twin elevating belts unload onto twin horizontal belts which run 885 feet across the full length of the building above the storage bunkers. A movable tripper device enables an operator to unload the coal into any one of the 10 bunkers from which the coal flows by gravity into a pulverizer prior to use.

Received coal destined for storage is transferred from the underground pick-up point below the crusher onto a 336-foot conveyor section leading to the stockpile area. To reclaim coal from the stockpile for plant use, two other conveyor belt sections operating in tunnels are loaded from hoppers near the toe of the stockpile and return the coal to a transfer point beneath the crusher.

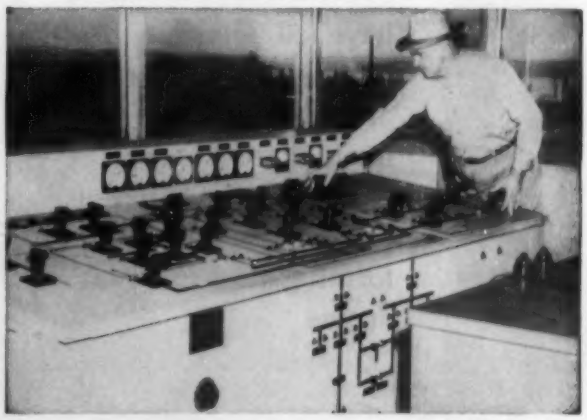


Fig. 2—Central control panel is located on top of crusher building. One man can control movement of coal over interlocking network of endless belt conveyors

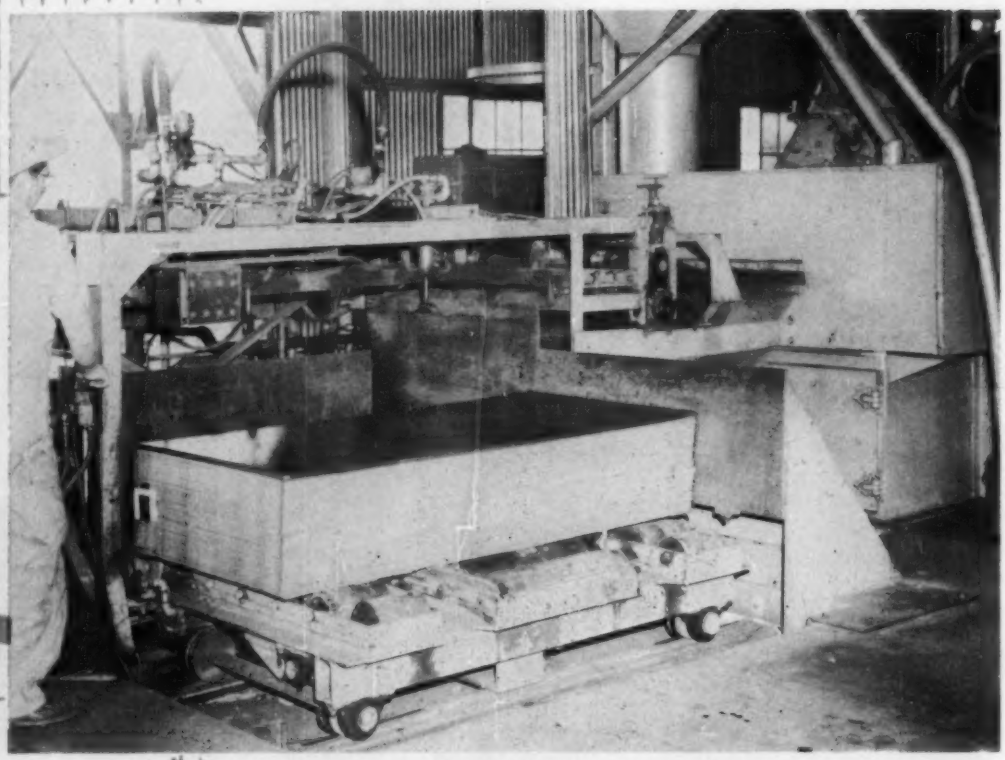
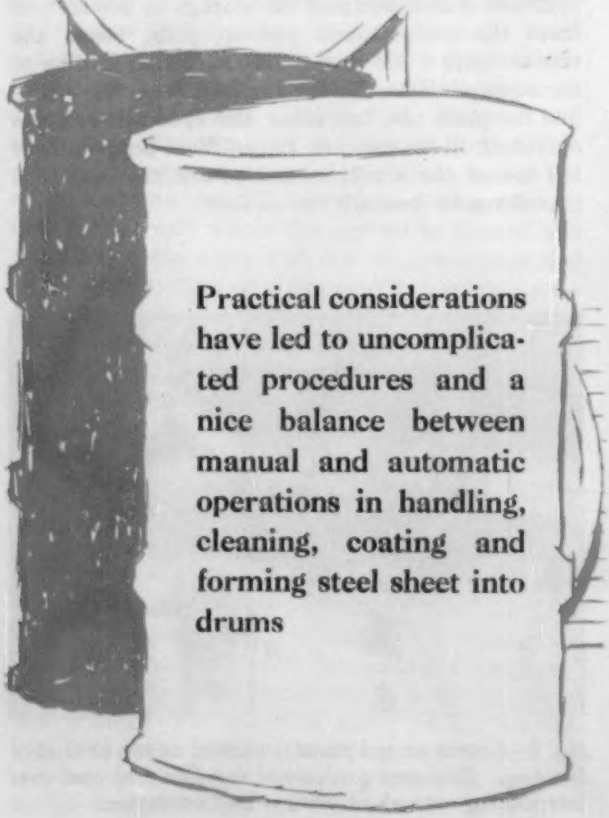


Fig. 1—Steel sheets are individually transferred from palletized bundle to conveyors by automatic Dexter feeder. This is a view at entry end of metal cleaning and surface treatment operation

PRODUCING STEEL DRUMS

By GILBERT C. CLOSE, Hawthorne, Calif.



Practical considerations have led to uncomplicated procedures and a nice balance between manual and automatic operations in handling, cleaning, coating and forming steel sheet into drums

TO THE LAYMAN, the term "automation" often conjures up a picture of industry transfigured to exotic and mysterious proportions, wherein automatic "brains" formulate coded orders and meter them into a vastly intricate control system, which in turn operates a production line without the aid and interference of the human element. To the practical operating plant or production engineer, automation is more liable to suggest the "welding" together of already existing but separated production processes into a homogeneous production unit, thereby reducing material handling operations, increasing rate of production, and maintaining consistently high quality production.

This latter interpretation applies very well to the automated industrial steel drum production line now in operation at Rheem Mfg. Co.'s South Gate, Calif., plant. Calculators, control tapes, and delicate sensing equipment are conspicuously absent along this line. Any one of the involved processes could be set aside by itself and with only slight modifications continue to operate. Vastly

increased material handling, increased personnel requirements, and a serious lack of co-ordination throughout the production cycle would occur, however, if the production processes were separated.

By welding these processes into a mechanically co-ordinated unit, Rheem engineers have reduced the above problems to the vanishing point. As a result, some 20 employees can produce 50 or 60-gallon industrial steel drums at a rate of approximately 600 per hour continuously. There is no piling up of in-process work anywhere along the line. When the raw material for a drum enters one end of the line, it is because a finished drum has been ejected from the other end.

Surface Preparation

In detailed perspective, the Rheem drum line actually consists of three automated sections, each performing a series of related operations. The first two sections — metal cleaning and surface treatment section, and painting and lithographing section—are logical break points in the manufacture of a steel drum; these breaks allow the insertion of different orders along the line without waiting for the line to clear one order before the next is begun. Also, because these first two sections are capable of a higher production rate than the final drum fabrication section, they can be used for the cleaning, surface treating, painting and lithographing of sheet steel for other Rheem products between orders for the drum line. The arrangement is one of convenience, with the "breaks" intentionally inserted to provide these advantages.

A trip along the Rheem drum line is in itself a revelation of how automation can be achieved principally by means of mechanical linkages and isolated controls without utilizing any of the numerous network control systems so often associated with this type of production. With the exception of basic standard machines, the equipment is company designed.

Metal cleaning and surface preparation for the drum line, as well as for other Rheem sheet metal production lines, is accomplished by two employees and a series of machines connected by a continuous conveyor which feeds the sheets automatically from one process to the next. The first machine in this series is an automatic feeder which loads the sheets, one at a time, onto the conveyor belt, *Fig.* 1. The sheets travel first through a Wheelabrator, where the surfaces are grit-blasted clean. Beyond the Wheelabrator, the sheets travel through an Aetna roller-straightener where any warpage caused by grit blasting is effectively ironed out. After straightening, the sheets proceed through a Rheem-designed hot water washing machine where water at 180 F and under 55 psi nozzle pressure washes away all loose dirt and metal particles.

After washing, the sheets are squeegeed dry by a set of rollers and then move onward through another set of rollers where a phosphatizing solution used for surface treatment is applied by a roller coating action. Beyond the phosphatizing rolls, the sheets are squeegeed again, pass through a drying oven, and then to an automatic stacker which bundles them for transportation to the painting department.

Rate of production for this portion of the line is controlled by the 150 fpm travel speed of the conveyor belt. Automatic desludging of the hot wash water permits its continual reuse—an important achievement in the Southern California industrial area. The two employees operating this

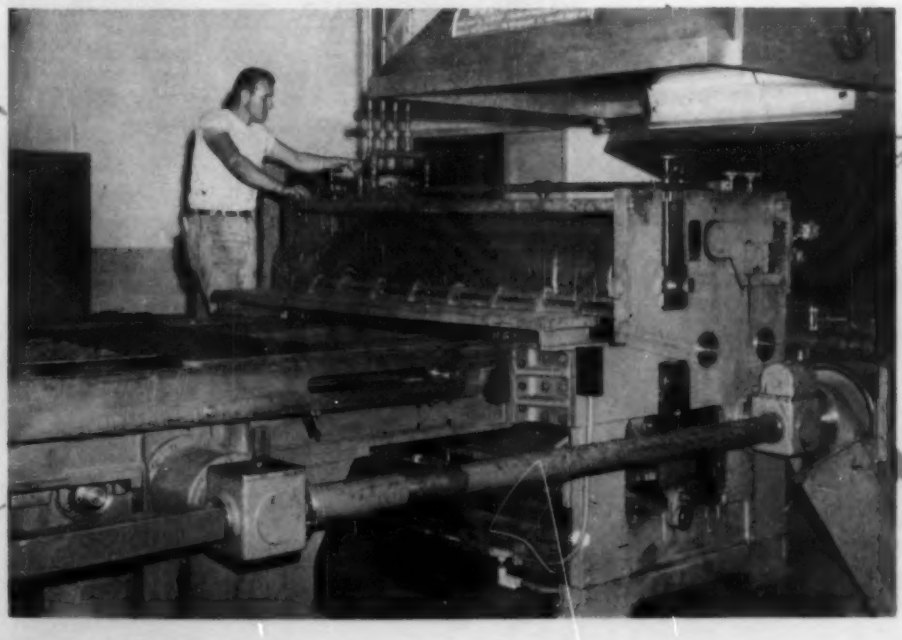


Fig. 2—Plain coatings are added to metal sheets by roller coater. Rolls of this machine are raised to clear conveyor when lithographing machine is in use

line are for the sole purpose of manning the two automatic stackers, each on an opposite end of the line.

A continuous conveyor is employed also in the painting and lithographing department. The same conveyor system is used by the lithograph and roller coating machines. The belt conveyor starts at the lithographing machine, continues onward through the roller coater, and thence to the wickets of a 150-foot long drying oven. This means that only the coating or the lithographing machine can be used at one time. The production speed on either is so great that this is no inconvenience and results in even better employment of the automated conveyor-drying oven combination.

In the coating operation, an automatic feeder places the sheets on the conveyor just before it enters the roller coater, *Fig.* 2. A bridge section of the conveyor between the lithographing machine and the roller coater is raised out of the way at this time. The roller coater is tooled to maintain a closely controlled and even coating thickness, and is largely responsible for the "Rheemcote Process" which assures complete coverage of the drum by a coating which protects its contents from metal contact when the drum is placed in use. Beyond the roller coater, the sheets feed into the wickets of a drying oven conveyor which index to receive each sheet as it arrives. At the end of the drying oven, another automatic stacker rebundles the sheets so that they can be returned for lithographing, or delivered to the final production line if lithographing is not necessary.

When the lithograph machine is in use, the bridge section of the conveyor is lowered, and the rolls of the roller coating machine are idle and raised, *Fig.* 3. The lithographed sheets thus pass through the roller coater and on into the drying oven, *Fig.* 4.

Drum Fabrication

The drum fabricating section of the line is a unified production unit that accepts the flat painted and lithographed sheet stock and ends up with the finished, inspected and tested steel drum. This part of the line is more specialized than either the cleaning or painting departments. Steel drums of from 50 to 60 gallons in capacity are produced by controlling the drum length (or height) without adjusting its diameter.

The most complex electrical control system employed anywhere along the line is found in this section. Limit switches are used at different stations all along the line to keep a constant rate of production and prevent any pile-up of work anywhere along the line. If, for instance, trouble is being experienced somewhere along the later section of the line, a limit switch flashes a warning backward along the line to control production in the preceding sections so that jamming cannot occur. At a few stations manual signals are used to flash the warning.

When the bundled sheets arrive at the beginning of this line, once again they are placed in process by an automatic stacker. The first conveyor transports the painted sheets through an edge grit blaster which cleans the edges of the sheets to be welded, *Fig.* 5. The sheets then go into an automatic roll former which forms the drum into its cylindrical shape. As the drum bodies kick out

Fig. 3—Some sheet is processed through the lithographing machine where desired designs are added to the metal prior to forming of the drum

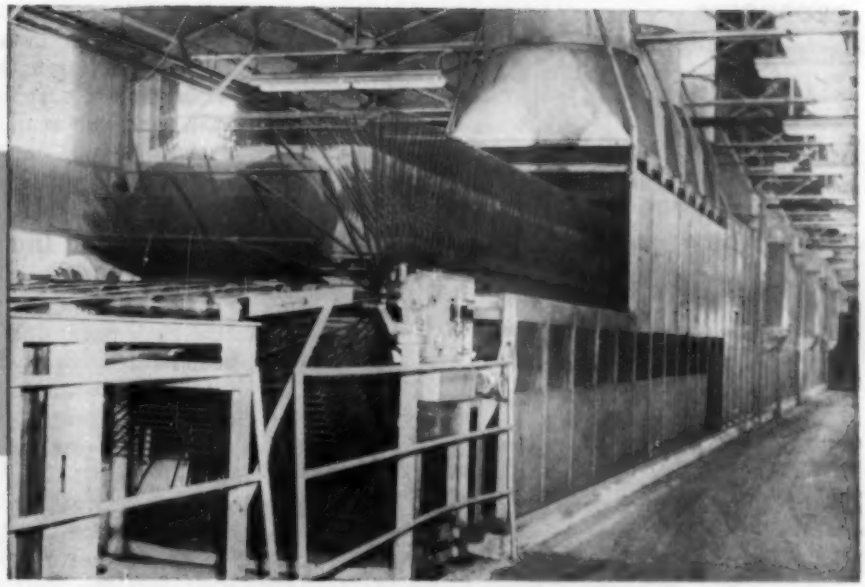


Fig. 4—Outlet end of 150-foot long drying oven. Wickets on oven conveyor hold sheet in vertical position during the pass through the oven. Discharge and restacking on pallets are automatic

of the roll former, they pass through an automatic roll seam welder which welds the vertical body seam. Beyond the welder, the weld seam is automatically cleaned and rephosphated by a system of exterior rollers. The interior of the weld seam is repainted by hand.

A substantial conveyor section beyond the roll forming and welding operations provides for considerable storage in view of the difference in rate of production of this initial operation and the subsequent final assembly and inspecting operations. This conveyor section will accept a number of formed drum bodies before it becomes filled and actuates a warning signal to halt the initial operation. Thus minor difficulties experienced along later sections of the line do not interfere with the initial forming and welding operation.

After the bodies have traversed this conveyor section, they are automatically tilted onto another conveyor which carries them into an automatic bottom and top flanging machine, *Fig.* 6. The bodies kick from this machine directly into another machine which completes the rim form and also inserts expanding mandrels into each end to roll form the rolling hoops on each drum in a swaging operation.

Just beyond these machines, an auxiliary production line feeds formed tops and bottoms into the main drum line. There are some variations in procedure at this point due to the various types of drums produced. As a rule, however, the tops and bottoms are hand-placed in position, then the drum passes into a machine which double seams the tops and bottoms in place by swaging together the preformed flanges on the drum body and the preformed flanges surrounding the end sections, *Fig.* 7.

Beyond this double seaming machine, the assembled drums index into a testing machine and are automatically filled with air at 15 psi. The

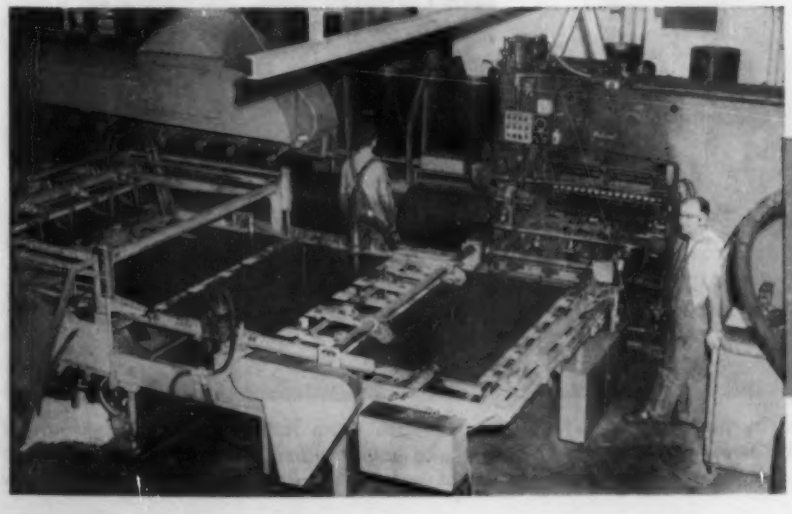


Fig. 5—In initial production operation, edges of sheet are grit blasted clean prior to body forming and welding operation. Series of small vertical rollers reapply (upper left) protective coating to weld seam

admission of this air into the drum is so sudden that it results in an impact stress, thus testing the overall strength of the weld seam. At the same time, a soap solution daubed along the weld seam and end seams indicates any isolated leaks, *Fig.* 8. Beyond this test, the drums are conveyed to the shipping section.

New and Old Combined

While Rheem engineers are the first to point out that their drum line is lacking some of the features commonly associated with automation in a literal interpretation, it is quite evident that they have proceeded toward automation along a path which must be followed by many industrial concerns who wish to automate, but who are already equipped with production facilities that can not be economically discarded. But progress must be served and Rheem engineers proceeded to weld existing equipment into the unified production setup described herein. And, as an inspector might write on a weld test report—"The fusion is satisfactory, though the weld bead itself is somewhat rough in spots!"

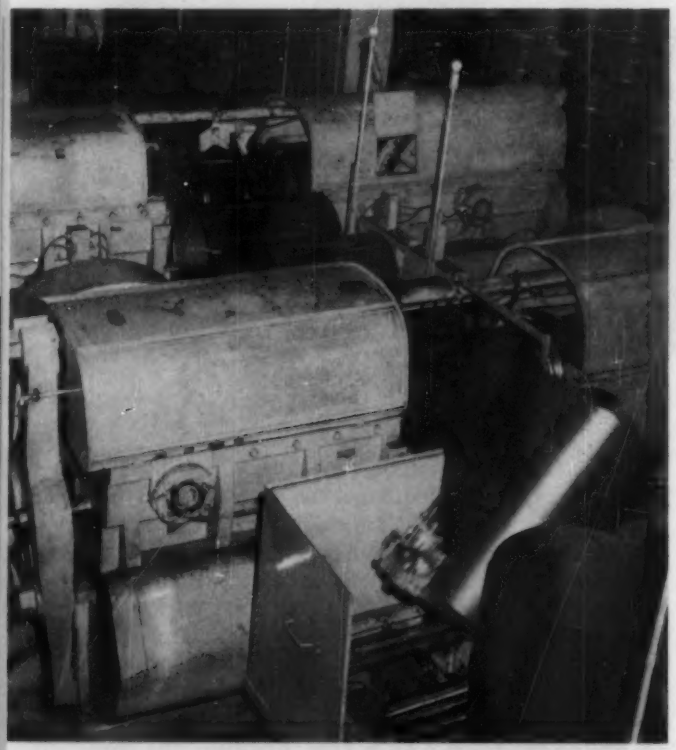


Fig. 6—End flanges and rolling hoops are automatically formed on drum bodies in a two-station operation

Fig. 7—Tops and bottoms are positioned by hand then automatically double seamed in place by swaging and crimping the body flanges with cover flanges

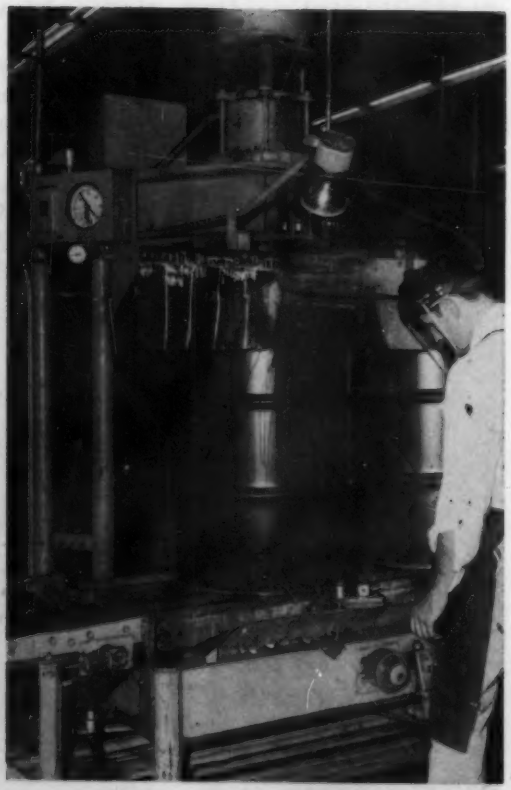


Fig. 8—Each drum is inspected for leaks along side and cover seams by introduction of air at 15 psi and use of a soap solution on the seams

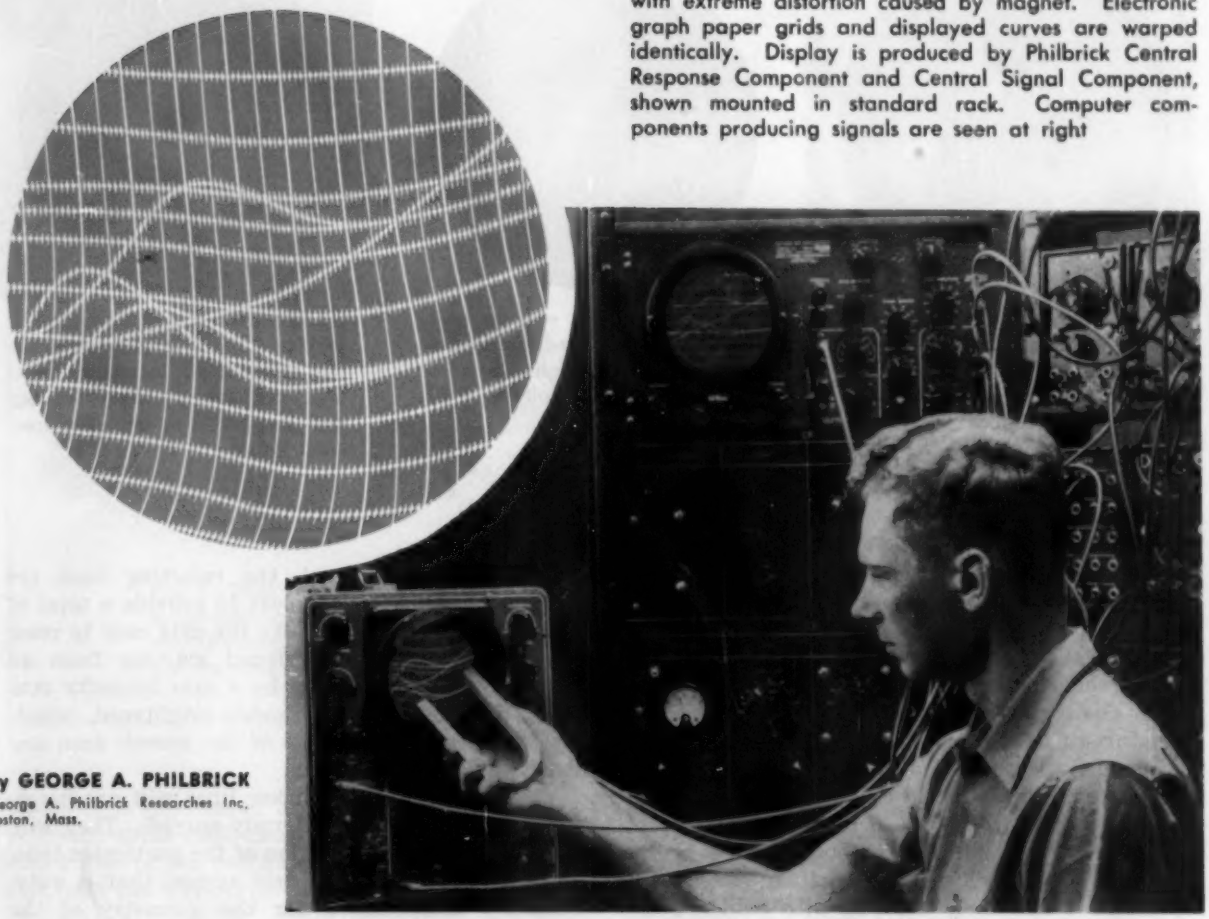


Fig. 1—Oscilloscope display stays in calibration even with extreme distortion caused by magnet. Electronic graph paper grids and displayed curves are warped identically. Display is produced by Philbrick Central Response Component and Central Signal Component, shown mounted in standard rack. Computer components producing signals are seen at right

By **GEORGE A. PHILBRICK**
George A. Philbrick Researches Inc, Boston, Mass.

SYSTEM ANALYSIS IMPROVED

WITH SELF-COMPENSATING OSCILLOSCOPE

IN DESIGN and instrumentation of automation systems, it has become increasingly important to observe, measure, and record physical variables. Nearly all graphical recording systems, including pen-recorders, optical-photographic systems, facsimile recorders, and oscilloscopes, share the same basic difficulties in display of variables.

First, the matter of establishing a fixed reference line, zero or otherwise, relative to which waveforms can be observed and measured is difficult in all types of recording. Once zero has been established, the display must be continually checked for drift to insure validity of the reference. In oscilloscope work, it is sometimes necessary to keep one hand on the vertical positioning control in order to keep the waveform properly referenced.

Then, unknown scale factors along both x and y axes often make the measurement of waveforms slow, tedious, and inaccurate. The standard procedure of injecting steps, spikes, or sinusoids for calibration purposes is an indirect approach. Usually the scribed scale lines on recording paper or oscilloscope face must be calibrated from the in-

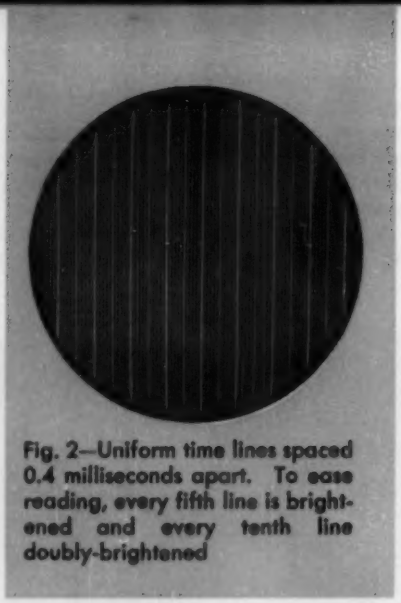


Fig. 2—Uniform time lines spaced 0.4 milliseconds apart. To ease reading, every fifth line is brightened and every tenth line doubly-brightened

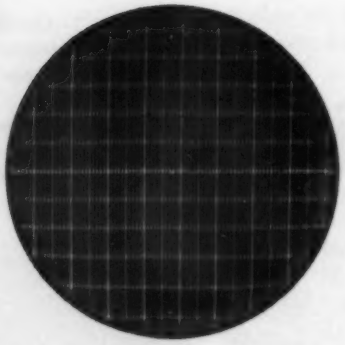


Fig. 3—Horizontal voltage calibration lines spaced at precise 10-volt intervals. Brightened zero axis divides −50 volt to +50 volt range

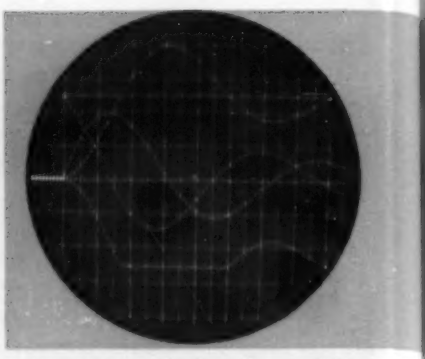


Fig. 4—Five displayed waveforms include 25-volt square-wave input, damped displacement, velocity, and acceleration waves, and a negative limited displacement wave

jected reference, and the waveform in turn calibrated from the scribed reference lines.

Nonliner, or distorted, graphical displays are ever-present, and no simple means has been available to compensate for the resulting graphical errors. Oscilloscopes in particular are haunted by curvature of field (barrel and pin-cushion effects), and much expense and toil have gone into the design of beam deflection systems that will conform to the arbitrary lines scribed on the scope face.

Display of multiple superimposed traces is impossible with recording systems having mechanical styli, and is extremely difficult with standard oscilloscopic systems. Multiple beam tubes and time-sharing techniques are both used, but are seriously limited as to their accuracy and the number of functions that can be handled.

Simultaneous calibration and compensation of multiple traces has been impossible to achieve heretofore. Now, a new development, so called electronic graph paper, allows values to be read from any one of several curves without regard for drift and scale factor change or for the distortion of a particular region of the display.

▶ Compensating System

The system shown in *Fig.* 1 solves the problems mentioned, using a conventional oscilloscope. It is inherently self-calibrating and self-compensating, has the interesting properties of achieving accuracy without enlargement of display and accommodates multiple variables without duplication of elements. The display has been designed to accommodate waveforms that extend from dc to a few milliseconds duration.

A uniform vertical scan, shown in *Fig.* 2, is the background for the display. This is much like a television scan, except for its vertical orientation, and is achieved by a 20 cps sawtooth on the horizontal sweep and a 2500 cps sawtooth on the vertical sweep and generates 125 vertical lines. Since many analog systems have a standard 40-millisecond computing interval, the resulting lines are spaced 0.4 milliseconds apart to provide a total of 100 fine divisions. To make the grid easy to read, every fifth line is brightened starting from an initial synchronizing step by z axis intensity control. Each tenth line is doubly brightened, resulting in ten major divisions of the overall scan and twenty submajor divisions.

These vertical time-marker lines will not necessarily be straight or uniformly spaced. They will, in fact, follow the distortion of the particular tube, and provide a reference grid system that is automatically compensated for the geometry of the oscilloscopic tube and the characteristics of the beam deflection system.

On the vertical grid, voltage calibration lines are produced as shown in *Fig.* 3. These calibrated y axis scale lines are spaced at ten-volt intervals from −50 volts to +50 volts, achieved by momentarily stopping the vertical sweep as the input deflection voltage passes through the standard calibration voltages. The vertical scan in voltage form is compared in passing with the set of constant voltages, and at each crossing the sweep is delayed. The resulting increase in dwell-time of the beam results in a brightening of the sweep at the desired ten-volt intervals. Again, nonlinearities in the beam deflection system or the geometry of the tube itself result in a slight warping, or compensation, of the y axis calibration lines.

On the calibrated and compensated rectangular grid, *Fig.* 3, five or more waveforms can be displayed simultaneously. As shown in *Fig.* 4, the desired waves are displayed by intensifying the vertical trace as the deflection voltage passes through values of one or more of the waveforms to be displayed. Again, such intensification is performed by retarding sweep speed rather than by using z axis scope intensity control, *Fig.* 5. This technique results in simpler circuitry and easier synchronization than z axis modulation would require.

All of the waveforms can be read directly against the one graph paper grid system on the scope face.

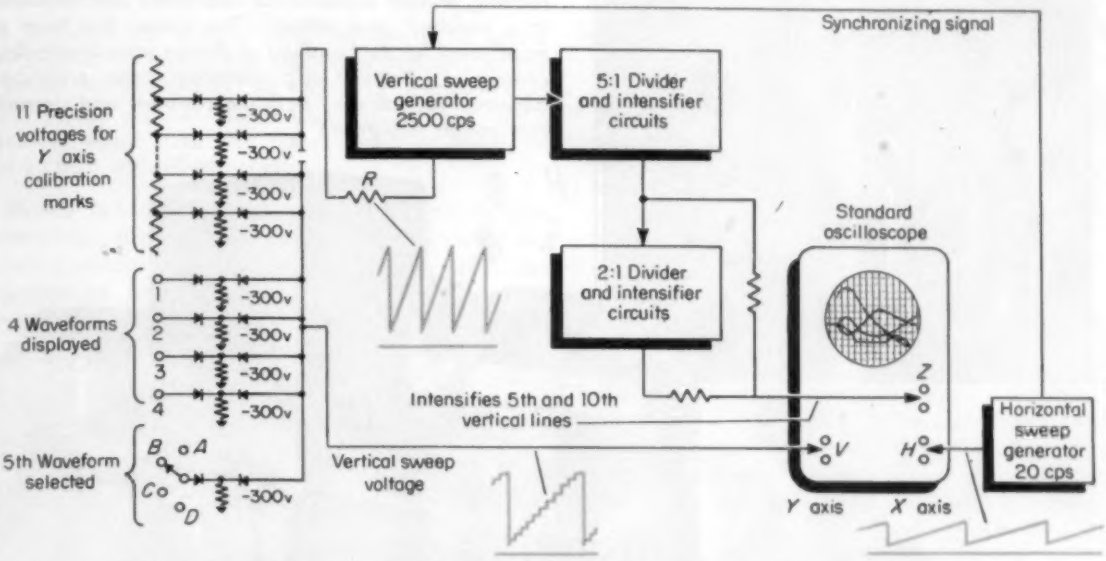


Fig 5—Block diagram for displaying 5 waveforms. The system is built around a scope having z axis beam intensity control in addition to the usual vertical and horizontal sweep control. Bright spots that define both the voltage calibration lines and the waveforms are produced by momentarily stopping the vertical sweep

There is no problem of drift since both curves and reference grids drift identically. Nonlinearities and distortions of the oscilloscope presentation also affect both the waveforms and the grid system alike.

▶ Application Advantages

In addition to the features of a drift-free, calibrated, and compensated display, the electronic graph paper presentation permits accuracies limited principally by the resolution of the oscilloscope itself. In its standard form, both time and voltage resolution is easily readable to 1 part in 100, and can be made accurate to 1 part in 500. Such results are achieved using a standard five-inch scope.

The technique is not limited to the presentation of only five waveforms simultaneously—as many traces as can be distinguished from one another can be displayed. A simple keying method can be used to flash a particular waveform on and off to identify the particular curve in a group.

Electronic graph paper techniques can also be used to plot the input-output performance of a component, computer, control system or subsystem. The input sawtooth used for the horizontal scan is also used as the input to the functional element. The output is plotted on the vertical *y* axis to provide an excellent input-output plot response curve on accurately-calibrated rectangular co-ordinates.

It is possible to plot "single-shot" non-repetitive functions on the electronically calibrated grid. Synchronism of the sweep with the event is required, and a long persistence tube and oscilloscope camera can be used to preserve the record. This display technique also allows a dc signal to be presented on an ac scope, as is the case of the horizontal voltage calibration lines themselves.

An unusual oscilloscopic display is the calibrated cross-plotting of two variables, as shown in *Fig.* 6. Such presentations, called phase-plots, lend themselves well to graphical interpretation.

Types of functions that can be displayed by this technique are varied. It is particularly useful for repetitive functions as in high-speed analog computation. Here twenty or more solutions can be performed per second, and five or more variables of the system displayed simultaneously. Since the interaction between variables is usually of primary significance, this display can be extremely helpful in optimizing the design and adjustment of a system.

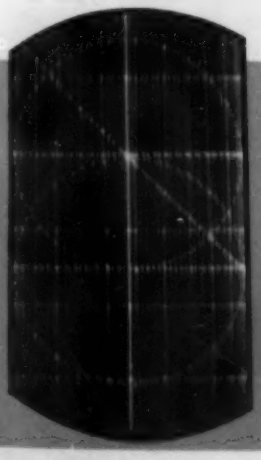


Fig. 6 — Cross-plot (or phase-plot) of one variable against another. Sloping line is velocity vs. velocity. Upper circle is displacement vs. velocity and lower circle is acceleration vs. velocity for undamped oscillatory second-order system

Fig. 1—Character recognition equipment capable of reading printed alphabetical characters and converting to a punched card output. This system has been demonstrated for the handling of charge sales in petroleum companies. Point of origin recorder, inset, produces a document readable by both the customer and character recognition equipment

NEW CODING SYSTEMS

BROADEN DATA PROCESSING

By P. B. GARROTT
Director of Market Development
Standard Register Co., Dayton, Ohio

In order to extend integrated data processing into several diverse areas, dialects of the common language system have been devised. Results provide a vehicle for introduction of automation improvements in fields varying from banking to warehousing

COMMON LANGUAGE can be described and explained by its application to certain types of office machines and to certain types of punched paper tapes. Various types of business machines, capable of being operated automatically and interchangeably by the same piece of punched paper tape, are said to be members of the same common language family of machines. Correspondingly, the common language term is also applied to the piece of code-punched paper tape which is capable of operating such a variety of machines. The significance of this term lies in the fact that the average business operation involves the use and reuse of repetitive data. By punching data into strips of paper tape, using a code pattern, reuse of such repetitive data may be mechanized to a high degree.

The entire philosophy of the integrated data

processing idea has been summarized in these two simple rules:

1. Record data at the point of origin on office machines which create punched tapes or cards as the automatic by-product of the recording operation.

2. Process original and subsequent data on office machines which read and punch tapes or cards, so that all data are self-perpetuating.

Within the original concept of integrated data processing, the common language tape was the primary means discussed in connection with the objective of being able to interchange data between various machine processing methods. While punched paper tapes or cards represent one proven method of accomplishing this objective, other methods already exist or are in final stages of development. Some of these more esoteric processes are far enough advanced to indicate that they may supplement the function of punched tapes or cards in some cases—or may supplant them entirely in others—to get the data processing job done still faster and better.

To appreciate the relationship of these new developments to the subject of integrated data processing, we must keep in mind one basic fact. The raw material which business must learn to process as efficiently as possible, and with which we are presently concerned, is information or data. Integrated data processing is concerned with the manner in which such information may be recorded, stored, transmitted, reused, and otherwise processed to reach the end result desired.

▶ Character Recognition

Several months ago, The Farrington Manufacturing Company made their first public demonstrations of a character recognition system called Scandex. This company, long active in the embossed charge-plate field, has collaborated with the Intelligent Machines Research Corporation in the development of the unit illustrated in *Fig.* 1.

Function of this system might be said to be similar in some respects to that performed by punched paper tapes, a function which has been discussed at some length already. Similarity lies in the fact that the Scandex unit, like the punched paper tape, is capable of converting information from one machine language to another, automatically.

First demonstrations of this system were based upon handling of charge sales in petroleum companies. Such transactions begin in the service station making the sale. These stations, equipped with a simple imprinting device, record each charge sale in a combination of handwritten and imprinted data.

The customer's identification card contains repetitive information in the form of embossed characters on either a metal or plastic plate. When inserted into the imprinting device provided for that purpose, the embossed characters on the customer's charge-plate are transferred to the charge record by pressure. The charge record is a 2-part form,

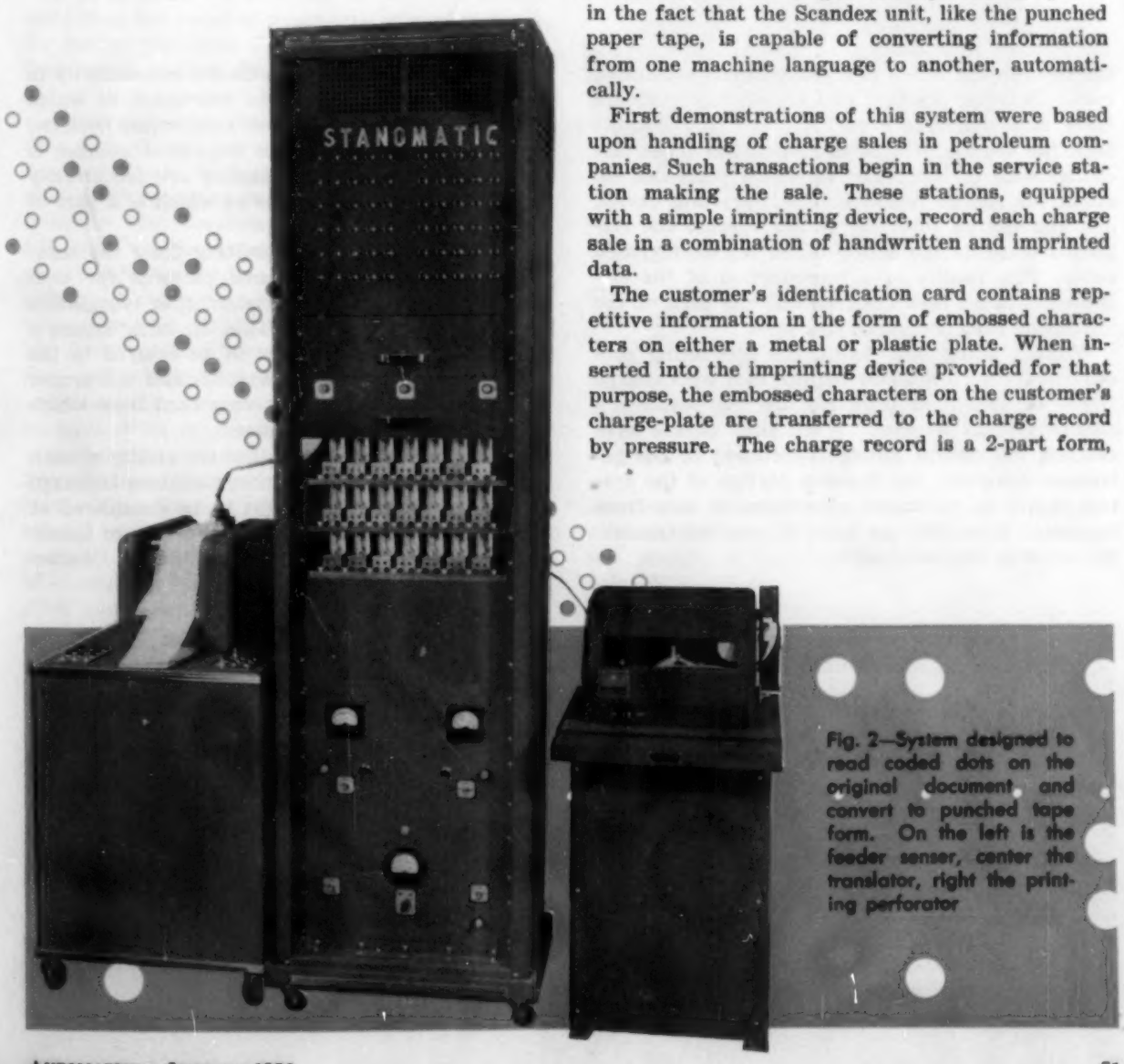


Fig. 2—System designed to read coded dots on the original document and convert to punched tape form. On the left is the feeder senser, center the translator, right the printing perforator

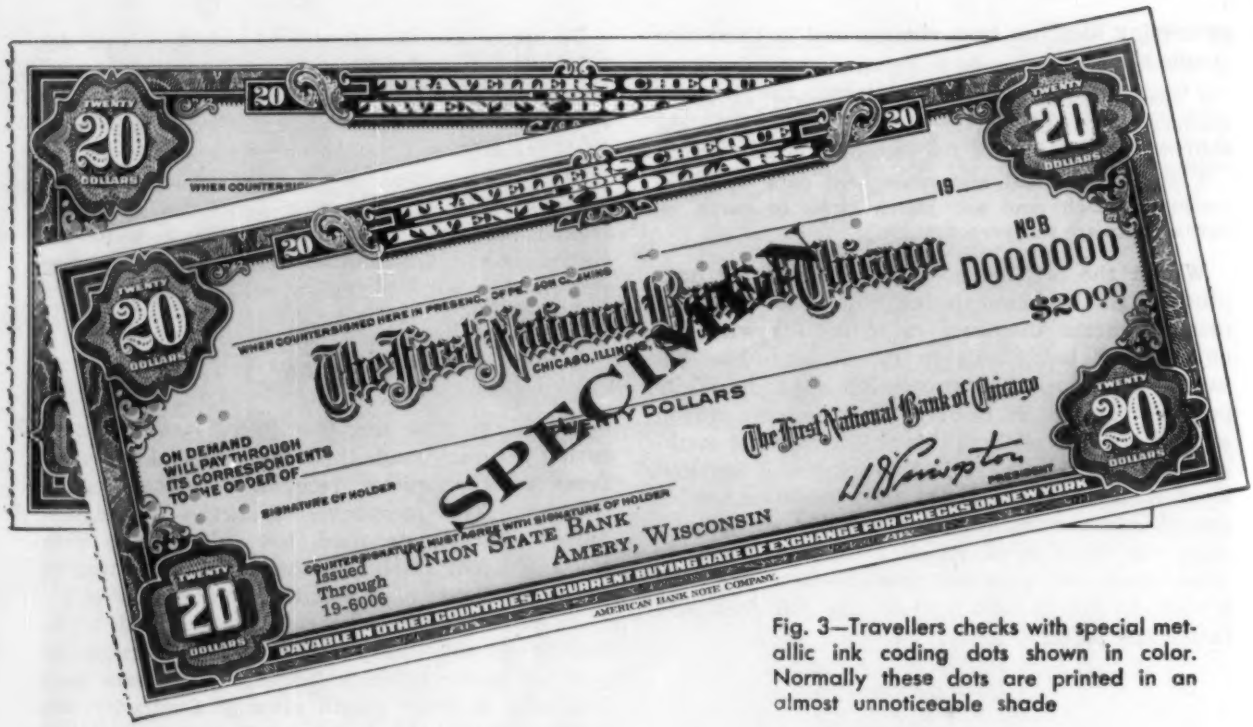


Fig. 3—Travellers checks with special metallic ink coding dots shown in color. Normally these dots are printed in an almost unnoticeable shade

the top copy of which is a conventional tabulating card. Between the first and second copies of this form is a double-face carbon—so called because both the front and back of the carbon tissue are coated with carbon. The embossed plate lies beneath the charge record in the imprinting device, and the charge form is pressed against the embossed plate by the action of an ink-impregnated roller. This results in a reproduction of the embossed data on both the face and the back of the tabulating card portion of this form.

Without going into detail, the accounting procedures for such systems require that each charge ticket be identified primarily by the customer's charge account number. When such tickets have reached the central billing department of the petroleum company, the Scandex portion of the system makes an automatic conversion of data from imprinted form into the form of punched tabulating codes in the same card.

Each charge ticket is positioned momentarily in a scanning area confined to the space in which the customer's charge account number has been imprinted. Each digit in the imprinted number is scanned. Results of the scanning are fed directly into an electronic digital device which is a part of the system.

The electronic pattern resulting from the scanning is compared with stored patterns for each possible digit, resulting in matching or recognition of the proper character. This, in turn, causes a series of electrical impulses to be relayed to the card punching unit of the system, and the proper codes are punched into the same card from which the imprinted data was scanned.

There can be little doubt that the ability of such a unit to translate data from one machine language to another earns it the right to be considered at least a first-cousin to the common language family of integrated data processing machines. Charac-

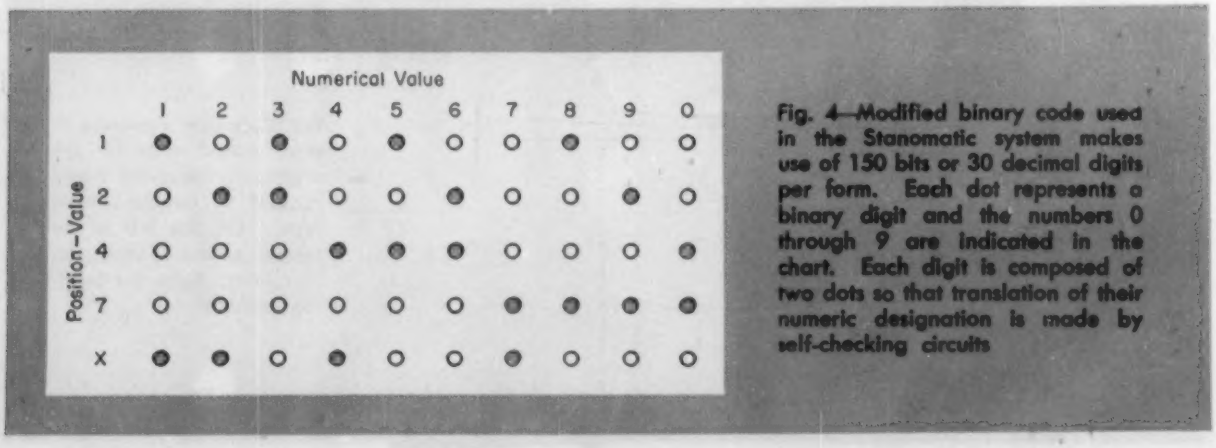


Fig. 4—Modified binary code used in the Stanomatic system makes use of 150 bits or 30 decimal digits per form. Each dot represents a binary digit and the numbers 0 through 9 are indicated in the chart. Each digit is composed of two dots so that translation of their numeric designation is made by self-checking circuits

ter recognition, in general, is being watched with a great deal of interest in many quarters. It is to be hoped that many of the present limitations and technical difficulties involved will disappear during the course of future development, and that such units may soon become practical for a wide variety of applications.

▶ Metallic Ink Spot Code

Going back to that first rule of integrated data processing, note the significance of the wording, "Record information *at the point of origin* on office machines which produce punched paper tapes or cards as an automatic by-product of the recording operation." This wording stresses the importance of recording significant data in mechanically reusable form as early in the transaction as possible. Equally obvious is the fact that punched paper tapes or cards were considered to be the most practical way for making such a mechanically reusable record of data—at least at the time this rule was formulated.

If we broaden our horizons, however, to include more than the punched paper tape or card methods for storing repetitive data, we find that there is a field-tested system for encoding repetitive data for automatic reuse. The system involves use of a modified binary code in the physical form of dots of a special ink deposited upon the original document itself. With this system, every character or digit of repetitive data which appears in legible form on the document itself is also coded in dot form on the same document. By means of some relatively simple electronic circuitry, another unit of this system, *Fig.* 2, is able to interpret these coded data, translating them into corresponding electrical impulses which may be used to produce any mechanical or electronic form desired.

Before going into details of the system, a simple example of its application is in order. During recent years, the issuance of travelers checks by the First National Bank of Chicago has increased tremendously. Such checks may be sold by any of several hundred agent-banks in cities all over the country. First National had the growing problem of accounting for batches of traveler's checks supplied to each of their agent-banks and of reconciling cancelled checks as they were returned to First National of Chicago through clearinghouse routines.

This accounting routine involved a considerable amount of manual work. When an agent-bank requested a batch of fifty travelers checks in 20-dollar denomination for example, First National would prepare those checks for delivery to the agent-bank. This would involve the imprinting of the agent-bank's name and clearing-house number and the creation of a punched card record of each check in that batch. Those accounting cards were punched with the serial number of the check; the code number of the agent-bank; and the denomination of the check,

After such accounting records were established and the traveler's checks imprinted, they were delivered to the agent-bank for sale to customers. As each check was cashed and returned to First National, it was necessary for a reconciliation procedure to take place. A key punch operator would read the serial number, agent-bank's code number, and the denomination of the check from the cancelled check, punching these into a reconciliation card. With that information in punched card form, the job of matching it to the corresponding accounting card could be handled mechanically by conventional tabulating equipment.

As First National's volume of travelers check business increased, thousands of such cancelled checks were being returned daily. This required the use of a steadily-increasing number of key punch operators in order to keep up with the increasing volume of cancelled checks. Since manual key punching operations are, for a number of reasons,

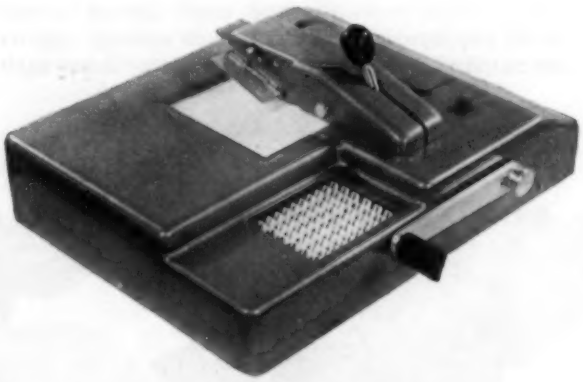


Fig. 5—Autographic register of the Stanomatic system which is typical of a broad class of devices created to facilitate preparation of handwritten records. In addition to reproduction of embossed plate information, this register is equipped to encode selected information in the dot code through the keyboard

an almost constant source of problems in connection with a tabulating installation, an alternative method of handling this transaction was developed.

With the new method, accounting data are punched into an accounting card in much the same manner. Likewise, the name and code number of the agent-bank are imprinted on the new travelers checks, *Fig.* 3, but, at the same time, each serial number, denomination, and the agent-bank's code number are also imprinted in the spot code. The type of ink used in imprinting these codes, incidentally, is almost colorless and likely to be overlooked entirely by a casual observer.

Data being coded upon the face of the check in this special type of ink now conform to that portion of the second rule which ends with the words "thus making all data self-perpetuating."

When such coded travelers checks are cashed and returned to First National of Chicago, these spots of ink demonstrate this self-perpetuating char-

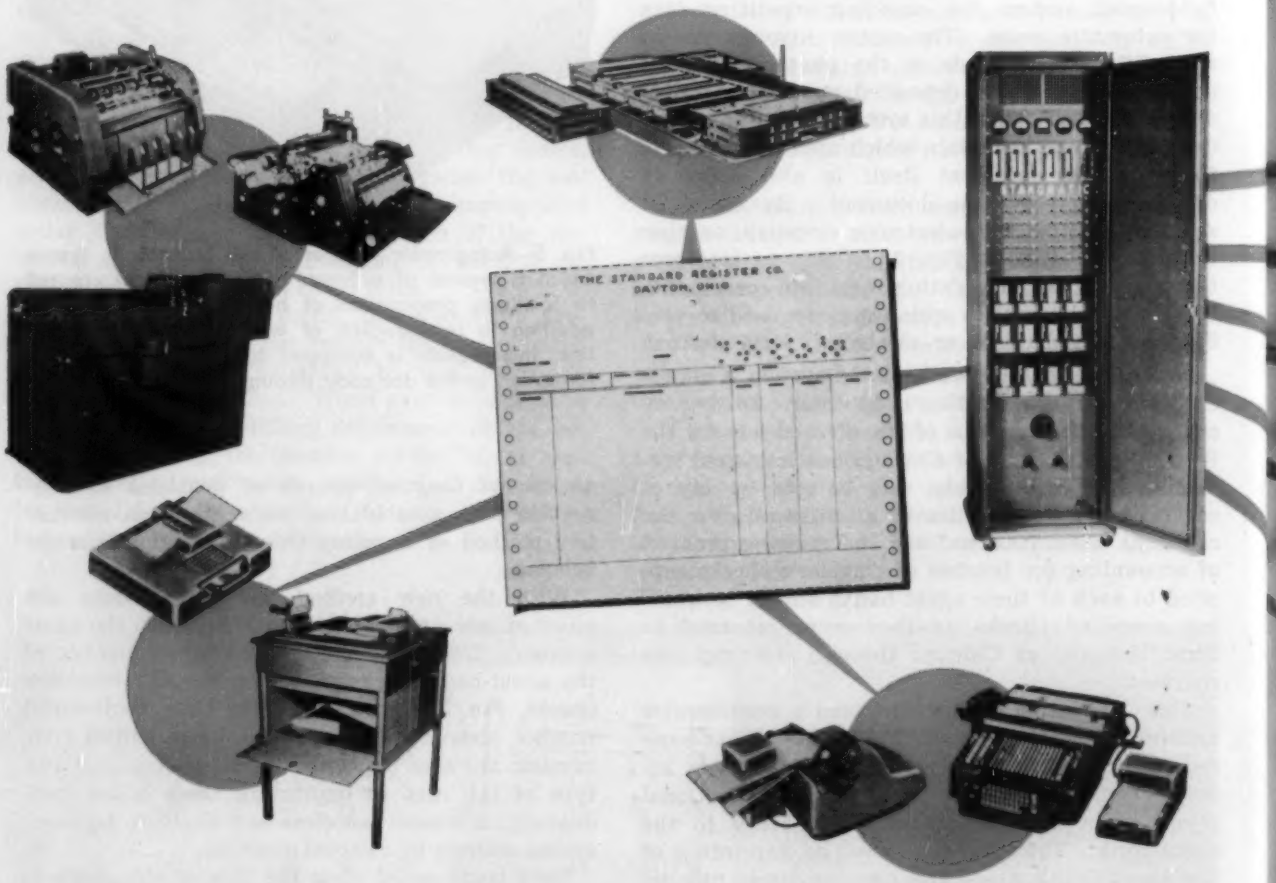
acteristic by punching their own reconciliation cards automatically. The cancelled checks are processed through a sensing device which detects the coded spots, converts the codes into electrical impulses corresponding to the correct numerical digits, and causes those digits to be punched into a tabulating card at the rate of 600 documents per minute.

Sensing circuitry is, of course, the heart of this process. When in the sensing position, each area in which a spot could possibly appear is brought within an electronic circuit of balanced capacitance. Being binary in nature, each circuit needs only to decide whether there is a spot present or whether there is no spot present. Since there are five possible portions in which spots might appear to represent any numeric digit, five such sensing circuits are required for each number involved. After each of the five circuits has reached its own binary decision, the combination of these decisions is then translated into an equivalent numeric value in the decimal system. In this example, the resulting decimal values are expressed in the form of electrical impulses to a tabulating card punch.

Industrial Applications

It is reasonable to assume that few production men will be directly concerned with the problem of accounting for travelers checks in great volume. There are, nevertheless, several principles involved which forward-thinking production men will find interesting.

Code spots of the type discussed, *Fig.* 4, may be applied as a part of the recording operation, regardless of the method being used in making the record. In the case of the previous example, codes were applied by means of a modified printing press, since the nature of the data involved lent itself to that type of imprinting. The flexibility of this process, however, permits similar coding of repetitive data upon handwritten or typewritten docu-



Sensing Head → Sensing Circuits → Verify

ments as well as those produced by bookkeeping machines, Teletypwriters, tabulating machines, or any other common method employed to imprint legible information upon paper forms.

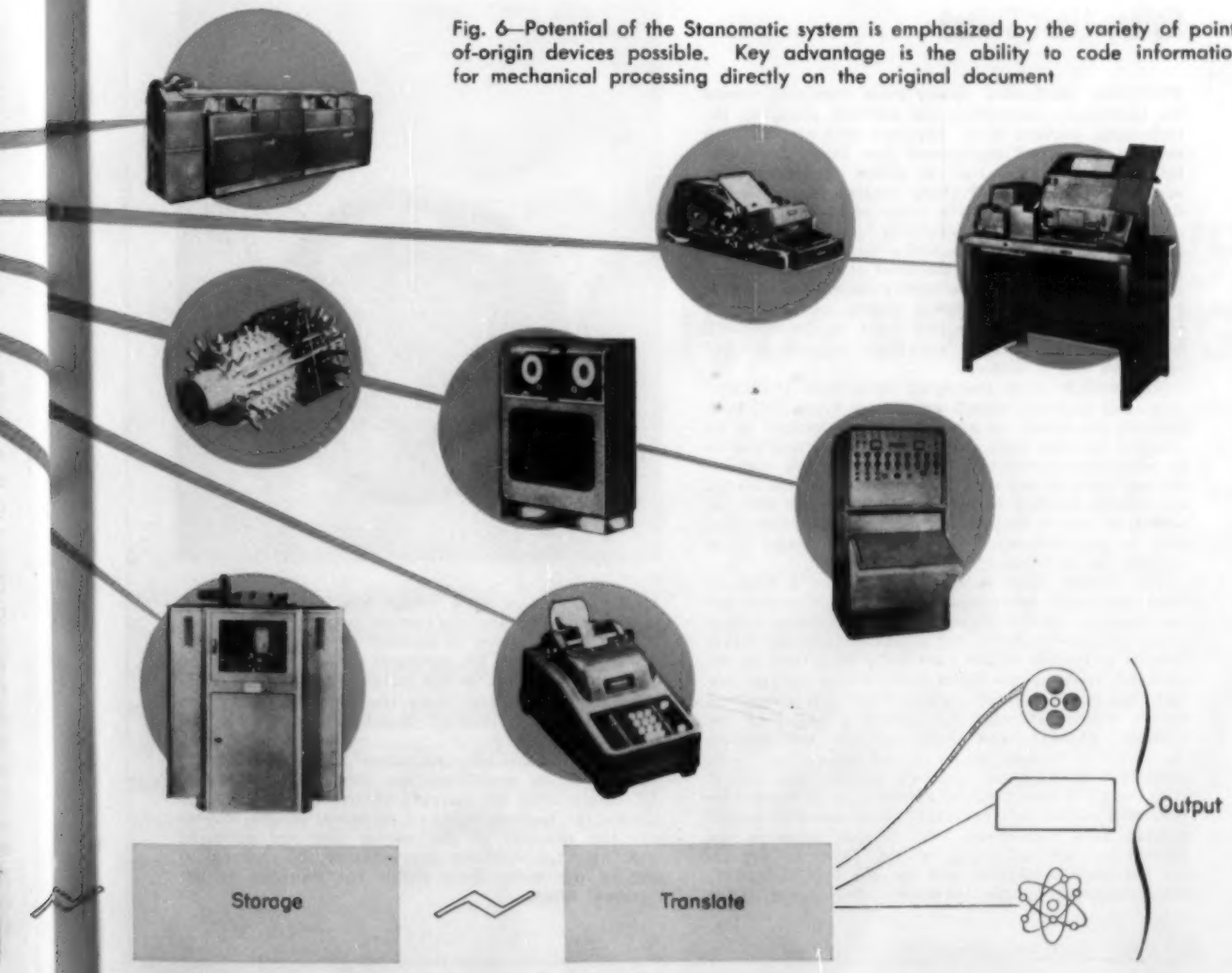
To illustrate a possible application of this idea in connection with handwritten records, visualize some of the data-handling requirements of a common job such as the issuance of material in a plant. Many plants maintain inventory and material control records in the form of tabulating cards. In such cases, a copy of each material requisition usually serves as the source record from which an operator punches a corresponding tabulating card manually. Sometimes, the discrepancy between *book* and *shelf* inventory figures may be traced to the fact that some of the material requisitions covering stock issued were never received in the tabulating department, hence never reflected in the book figures. Use of an autographic register, *Fig.* 5, could provide adequate protection against the loss of such vital records. If that autographic register were equipped with a spot-coding device, it could guarantee the double dividend of assuring that a record of every stock transaction reached the tabulating department, and providing the ability to punch its own tabulating card without involving manual key punching or any verification.

In the same general manner, this idea may be applied to any record writing operation without regard to the type of writing equipment involved. The physical arrangement for imprinting the coded data may vary, of course, depending upon the characteristics of the machines involved. On a key-driven machine, such as the ordinary typewriter, this might involve the provision of a memory device in which desired data could be stored during the actual typing of the legible data. The stored data might then be read out of the storage unit and imprinted upon the corresponding document as the form issued from the carriage of the machine, or as a subsequent and separate operation.

Regardless of how those code spots might be placed on the form, the fact remains that such coded data may be translated directly from these forms into punched paper tapes, punched tabulating cards, embossed metal plates, or magnetized areas on magnetic tapes or drums, *Fig.* 6.

Any production man whose plant contains conveyor systems providing alternate routings may

Fig. 6—Potential of the Stanomatic system is emphasized by the variety of point-of-origin devices possible. Key advantage is the ability to code information for mechanical processing directly on the original document



find this system worth considering. Suppose that cases being moved on the conveyor system are identified with some of these spot codes we've been discussing. And suppose further that each switching point in the conveyor system were to be equipped with a sensing unit by which it could read each case as it arrived at the switching point. By means of an automatic decision-making unit at each possible branch in the conveyor system, more automation could be introduced to the job of delivering this product to the consumer. Every one of thousands of cases would be identified, grouped with similar cases, shunted onto the correct tracks and, finally, delivered to the correct point without human intervention.

In the same general manner, any organization whose products lend themselves to standardized packaging might, by the use of some variation of the spot code idea, find it possible to make those products answer a sort of automatic roll call as they entered or left inventory. By the use of such code spots, many manufacturing operations involving counting, sorting, intra-plant routing and other related operations may some day add additional degrees of automation.

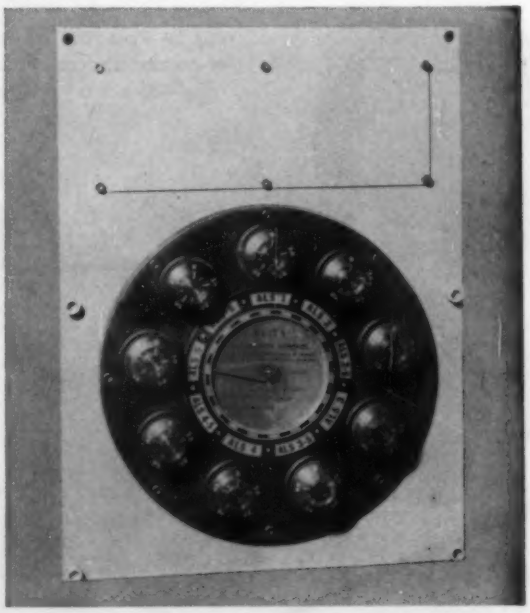
The Stanomatic system developed by the Standard Register Company has, up to this time, been applied only to the job of encoding significant business information upon paper documents of various sizes and shapes. However, by means of such a coding system, information originating in any form, at any point in a business control system, may serve as a fully automatic and direct input to digital computers. Significance of this possibility is apparent to all who are concerned with the problem of input to computing systems—and that takes in just about everyone who is concerned with computers in any way.

Rotary Limit Switch

PRECISE mechanical rotary limit switching device for electrically controlling the starting, stopping, interlocking, motion, time, sequence and recycling on modern industrial equipment has been developed by the E. W. Bliss Co. It offers an independent accurate adjustment of every control switch in the device through a complete range of zero to 360 degrees by means of a calibrated thimble and stem arrangement similar to that in a micrometer. All adjustments are made from the front of the device, facing the operator and all adjusting assemblies are provided with positive locking means. A calibrated stroke or cycle position indicator is incorporated into the device and all individual adjustments are zeroed to this indicator.

The switch units employed have both normally-open and normally-closed contacts in them, and both circuits are wired to terminal blocks located in an integral junction box. Either circuit (normally-open or normally-closed) may be seleced at will without the necessity of any wiring changes. Terminal blocks are clearly marked as to the normal circuit and the switch to which they are wired. Switch identification is provided on a circular etched metal plate around the position indicator.

The rotary limit switch actually has a total of nine switches incorporated into it. The nine switches are located radially around a single rotating helical cam. All nine switches are independently adjustable axially in respect to the cam helix by means of the external micrometer type adjustments. Zero adjustment is achieved through a tamperproof internal device which is locked in correct position at the factory. Rotation of the helical cam will actuate the switches through hardened and lapped steel balls contained in hardened nitralloy guides. The helical cam, which is also made of nitralloy, is supported by precision sealed ball bearings which are also locked against axial movement. All ferrous parts of the mechanism are subjected to the Pentrate process for corrosion inhibition and for the lubrication effects provided by the inhibitor. The switch drive



mechanism is of such design that no thrust loads are imparted to the mechanism proper.

The switch drive is located at the rear of the device and may be arranged for either vertical, horizontal or direct in-line drive. Standard drive arrangement is vertical from the bottom. All right-angle drives are through case-hardened steel spiral miter gears.

The entire assembly surpasses J.I.C. requirements in regards to enclosures for electrical equipment. All connections are harness cabled to the terminal blocks, the harness being of sufficient length to permit the removal of the switch unit for servicing and inspection without necessitating the removal of any of the wires from either the switches or the terminal blocks.

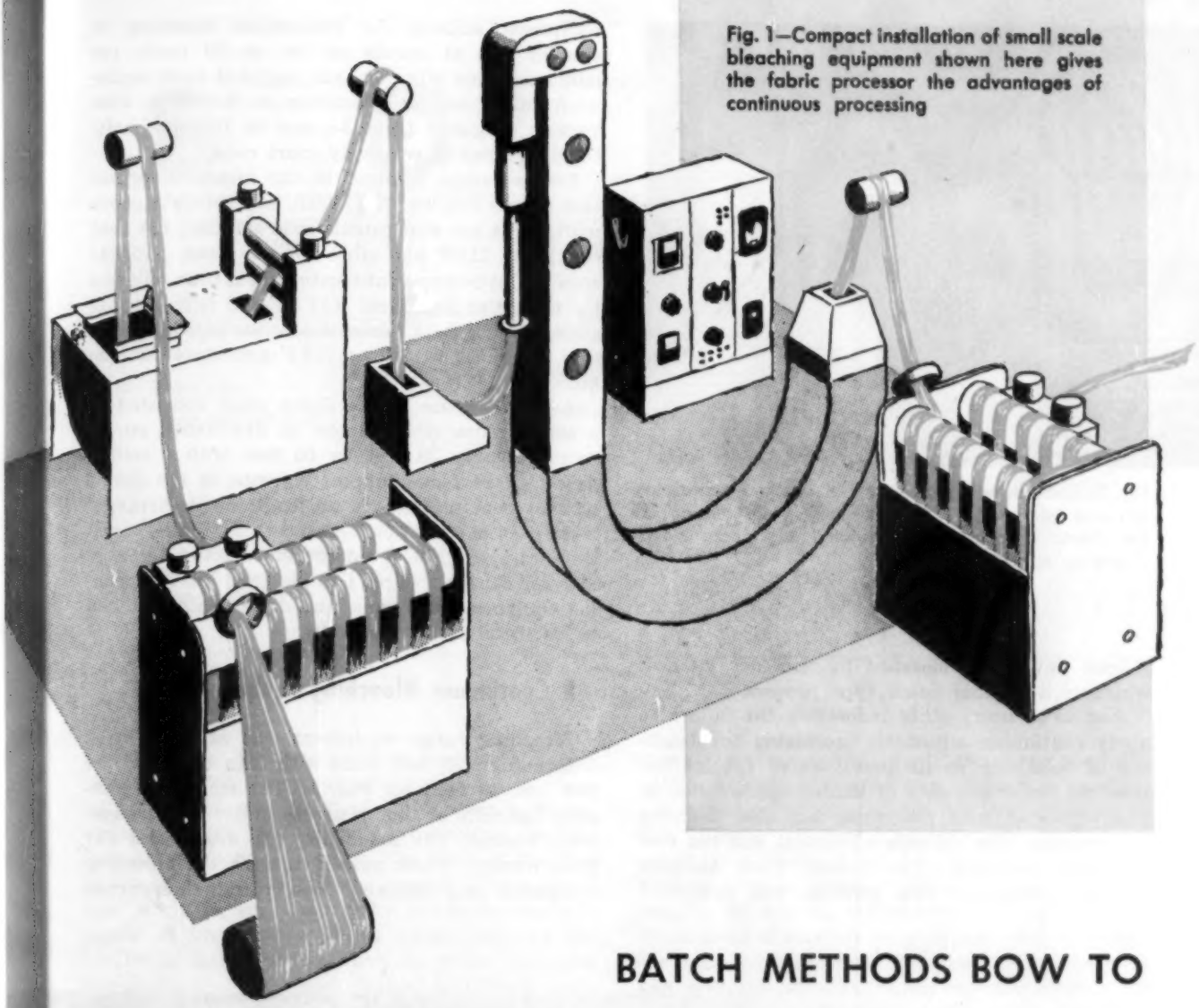


Fig. 1—Compact installation of small scale bleaching equipment shown here gives the fabric processor the advantages of continuous processing

BATCH METHODS BOW TO

CONTINUOUS BLEACHING

Processing materials by continuous methods is all too often ignored and less efficient batch methods used—because suitable continuous equipment is not available or possibilities apparent. Bleaching of relatively small quantities of cloth is a field in which this happens, but in the plant described here continuous bleaching has been applied

A MAJOR BENEFIT of the increasing consideration being given to the use of automatic operations is the expanding application of automatic processing techniques to relatively small production lots. Many industries in general and certain areas of many more industries have traditionally used manual, batch type procedures. This has been true even in industries such as the textile processing field where automatic continuous processing has been used for many years to process large volumes of fabrics. For example, bleaching operations processing 300 yards of cloth or more per minute by continuous methods have not been unique. Meanwhile, in the same industry and even in the same plants where such high production facilities were operating, smaller quantities of

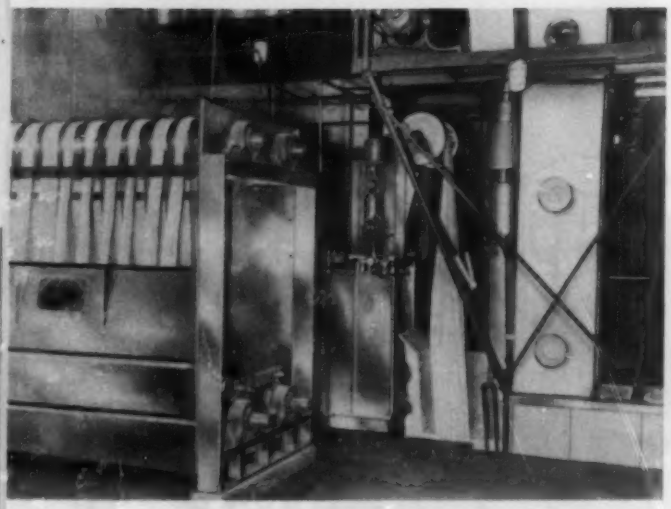


Fig. 2—Unbleached goods are fed into the washer at left and immersed 18 different times with tension of the fabric automatically regulated to obtain good cleansing without distortion

fabrics have been bleached by the kier method, which is a manual batch type process.

Just as in many other industries, the failure to apply continuous automatic processing to bleaching of relatively small quantities of fabrics has been the result not only of limited appreciation of possibilities of such processing but also the very real problem that suitable equipment was not economically available. The Rodney Hunt Machine Co. has recognized this problem and developed equipment suitable for continuous bleaching of smaller lots at speeds as low as 30 yards per minute. Bates Mfg. Co. has installed their equipment, and uses it effectively to bleach a wide variety of goods from 3-ounce to 10-ounce soft-filled sheeting in relatively short runs.

Process steps involved in the bleaching operation are as follows: (1) Wash, (2) saturate goods with 3 to 4 per cent caustic soda solution, (3) heat to 210 or 211 F and store for one hour, and (4) wash. This sequence of treatments is then followed by a similar cycle of: (1) Wash, (2) saturate goods with ¾ of 1 per cent alkaline peroxide solution, (3) heat to 210 or 211 F and store for one hour, and (4) wash.

Available space at the Bates plant consisted of a single room—a small one as dye-houses go. It measures only 38 feet by 63 feet with a ceiling height of 24 feet. Support columns in the center of the room throughout its length made arrangement even more difficult. A bleaching range, chemical storage, cloth preparation facilities, storage bins for caustic scoured and bleached fabrics, opening equipment, dry cans, and drive equipment had to be installed in this room.

Continuous Bleaching Equipment

Bleaching range equipment was arranged in a U-formation 35 feet wide with legs extending 14 feet and 19 feet, see *Fig.* 1. The equipment consists basically of four separate units: (1) Preliminary washer, (2) saturator, (3) J-box, and (4) final washer. Cloth passes through the bleaching equipment as a compact "rope" rather than spread

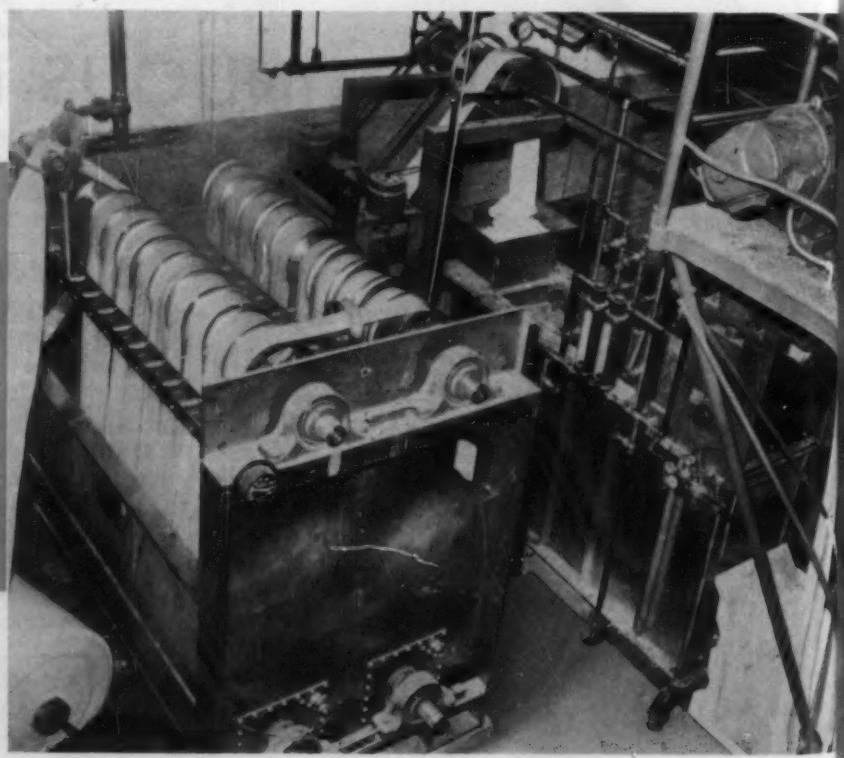


Fig. 3—From the preliminary washer the cloth passes to the saturator (in the center background) where the fabric is saturated with the necessary chemicals and water

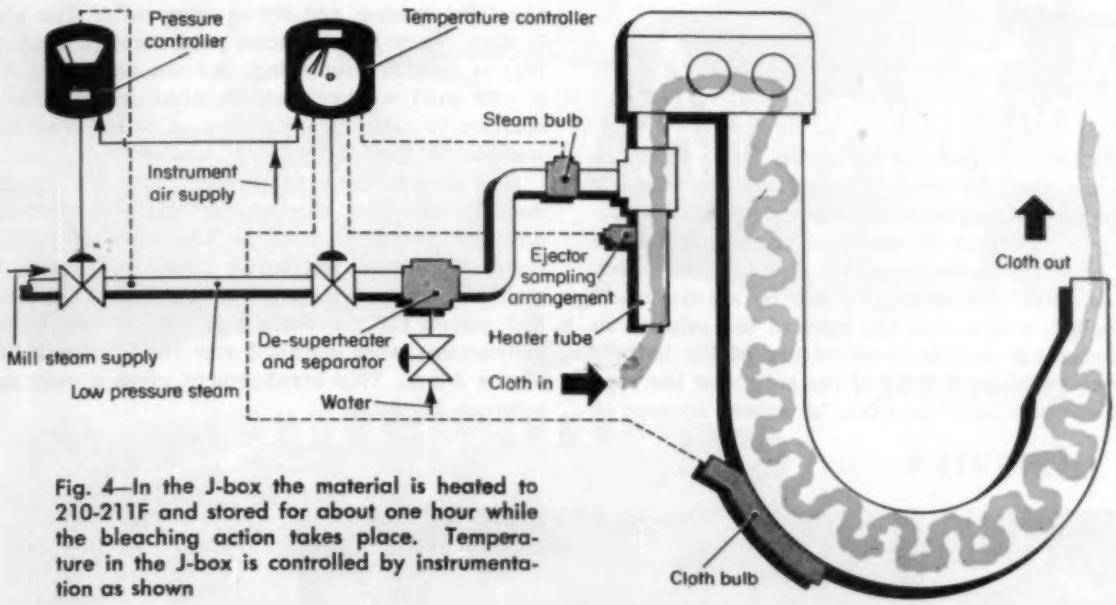


Fig. 4—In the J-box the material is heated to 210-211F and stored for about one hour while the bleaching action takes place. Temperature in the J-box is controlled by instrumentation as shown

to full width. Processing fabric as a rope allows use of much more compact equipment.

The washers are identical units which each immerse the cloth 18 times while controlling the tension of the cloth. Shown at the start of the line in *Fig.* 2 is the preliminary washer. These small size washers are similar to full-scale washers giving 28 immersions. Cloth passes through the washer in loops around upper rolls which are above the surface of the wash water, and lower rolls which are submerged. Tension is controlled by driving the bottom rolls only. In actual practice the bottom rolls of the machine are overdriven by a fixed amount. Any differences in tension result in various amounts of slippage of the goods on these rolls. The tension maintaining action can be studied by considering a single loop of cloth and the effect of driving the bottom roll. If the cloth stretches and therefore loses tension, the loops of cloth will tend to drop free of the driven roll. The roll will lose its traction on the cloth and will cease to propel the loop forward until the next driven roll has taken enough cloth away to restore tension of the cloth and draw it back against the first roll. If excessive tension develops, the loop is pulled more tightly against the overdriven roll; slippage is reduced; and the loop is advanced at a speed greater than that of the material on the next driven roll until tension and slippage reach a balance point.

This control of tension by the material itself is a worthwhile point. It does not require complicated drives to establish a certain tension in a strand or web of material. Also, this method does not result in a drastic series of grab and slip cycles. With a water film between the goods and the roll, changes in slippage of the fabric occur smoothly until a balance of tension and slippage is reached.

Adjustment of this balance point can be made to suit different fabrics. The stripper bar which serves as a doctor blade to prevent strands from sticking to the bottom roll can be adjusted vertically. By moving the stripper bar up or down, the amount of angular wrap of each strand around the roll is increased or decreased accordingly. It has been found that regulating the amount of angular contact effectively controls the setting of the balance point.

After leaving the preliminary washer through a set of squeeze rollers which extract water from it, the fabric goes to the saturator, *Fig.* 3. The pressure of the squeeze rolls can be pneumatically controlled to regulate the amount of water extracted. Entering the saturator the fabric carries an amount of water equal to about 90 per cent of its own dry weight. Leaving the squeeze rolls of the saturator the cloth carries treatment chemical and water equal to about 100 per cent of its dry weight. Squeeze roll units on the washers and saturator are identical and so can be interchanged or replaced with a common spare.

Chemicals are fed from a fairly simple gravity system with storage and mixing tanks located on a mezzanine adjacent to the J-box platform. Two 300-gallon stainless steel mixing tanks with separate flow meters are used alternately to feed chemicals to the saturator. This allows one batch of chemicals to be mixed while the solution from the other tank is being fed into the saturator. Many continuous bleaching ranges use proportioning pumps to meter the proper amount of chemical directly into the bath. Since the fabric

continually carries away water and chemical, makeup chemical and water must be steadily added at the proper rates to maintain the concentration and degree of alkalinity of the solution. In this plant, periodic titrations are used to check the solution. The alkalinity can be automatically controlled, and so can the level of the solution in the saturator and the temperature of the bath.

From the squeeze rolls of the saturator the rope of fabric goes into the J-box, so named because of its shape. In the J-box the material is heated to a temperature of 210-211 F and stored for an hour, while the bleaching is accomplished. The J-box used here is of the type developed by E. I. du Pont de Nemours & Co. Inc. The instrumentation controlling the temperature in the J-box, see *Fig.* 4, was supplied by the Foxboro Co. An alternate design of J-box developed by the Buffalo Electro-Chemical Co. Inc. is often used. These two designs represent independent plans to effectively heat and pile the goods in the storage chamber. The DuPont system preheats the single strand of goods before it is plaited into the J-box; whereas the Becco system plaits the saturated strand down into the storage chamber and the entire pile is heated by means of a steam chest on that chamber.

As in the case of the saturator, the J-box must be designed so that the goods will freely pull away from the pile with a minimum of tangles. This is why the storage chamber is designed in the shape of a letter J. During the storage period, the pile of goods slides down around the curve of the J and the bottom of the pile is upended so that the fabrics can be readily withdrawn.

From the J-box the fabric goes to and through the final washer and its squeeze rolls. The cloth is then ready for a second pass through this system or further processing. As can be seen in *Fig.* 5, the final washer was installed in an elevated position to allow gravity flow of water from that washer to the preliminary washer.

Roll speeds throughout the range are simultaneously adjusted through an adjustable voltage dc drive system supplied by Westinghouse Electric Corp. The packaged motor-generator unit is installed high and dry on a mezzanine. The control panels for the drive and the process control instruments were installed over the bottom section of the J-box. This arrangement gives a very neat compact layout.

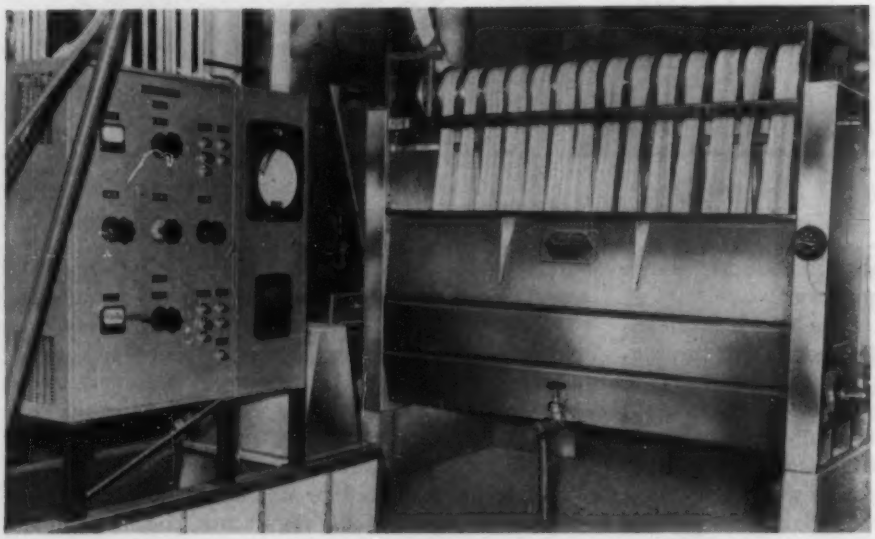
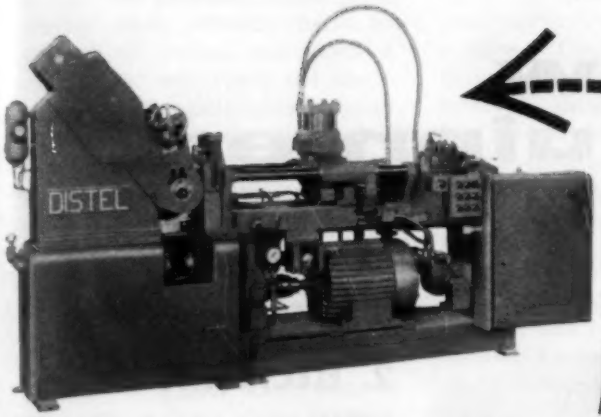


Fig. 5—Last stage of the bleaching range is the final washer at the outlet of the J-box. Instruments and drive control are conveniently located over the bottom section of the J-box. One man can watch the entire operation

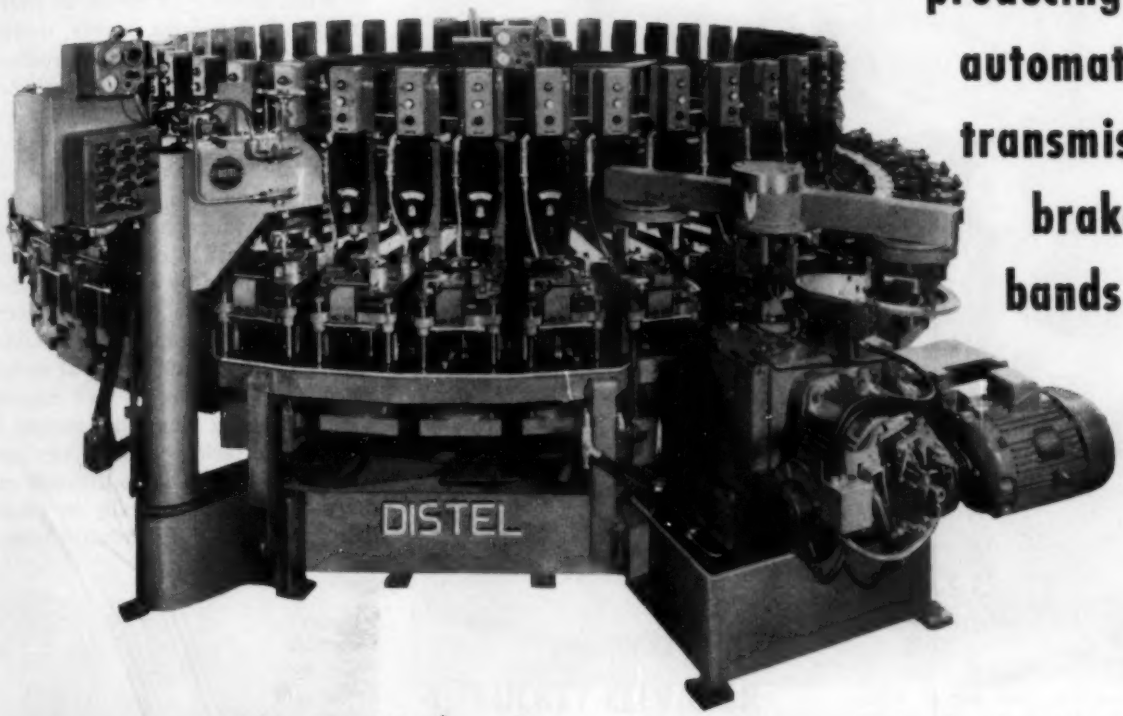
Some Advantages

Depending upon the particular operation involved, continuous automatic bleaching may have many advantages over kier or batch bleaching. Some of the possible improvements are as follows: Continuous bleaching may use less than half the water required for kier bleaching, and may use as little as 0.1 to 0.2 pounds of steam per yard of goods compared to 2 to 3 pounds per yard for kier methods. Chemical costs for continuous processing can average one third less than for batch bleaching, and continuous processing equipment may require 55 per cent less floor space than kier equipment of the same capacity. Also, by continuous bleaching, grey goods may be converted to white goods in 3 to 4 hours as compared to 16 to 24 hours in the kier method. Through the improved control which can be obtained with continuous uniform bleaching, quality of product can also be improved. Such advantages lead to lower costs and improved products—goals desirable for all types of operations.



Amazing Team FOR

producing automatic transmission brake bands



a new improved roll form & cut-off machine

constant roll forming and cut-off from coil stock

No lost motion—no lost stock—hydraulic cut-off. Both ends are rolled, formed and cut-off, with no flat ends. Stock Feed Guide bars are hardened and ground.

feeds to roll form, and cuts off, after the forming

Positive locking vertically and horizontally. Heavy, much improved stock-feed runs on ball bearings. Double-action cylinders assures rigid control of lengths.

produces perfect bands

Holds the radius constant at both ends. No convex or concave surfaces.

machine can be used year after year

Readily adjusts for model changes, and diameters varying from 6" to 10".

a new improved brake bonding machine

the "merry-go-round" has 42 stations

It's a rotating machine, with completely balanced weight. Ball bearing, 6' in diameter, provides stability and eliminates vibration. One-shot lubrication for the entire machine. Loading is semi-automatic. Unloading is automatic. Each station is readily accessible.

"merry-go-round" has positive index control

Entire machine can be adjusted to the time control and indexed slower or faster. It continues to operate even if one or more stations are down.

bonds brake lining to steel by low voltage electric heating elements

It bonds 360 brake linings per hour. Pressure is from an expanding air chuck. It's controlled thermostatically at each station.

each station is a complete unit

Each station operates with its own air cylinder, signal lights and gage.

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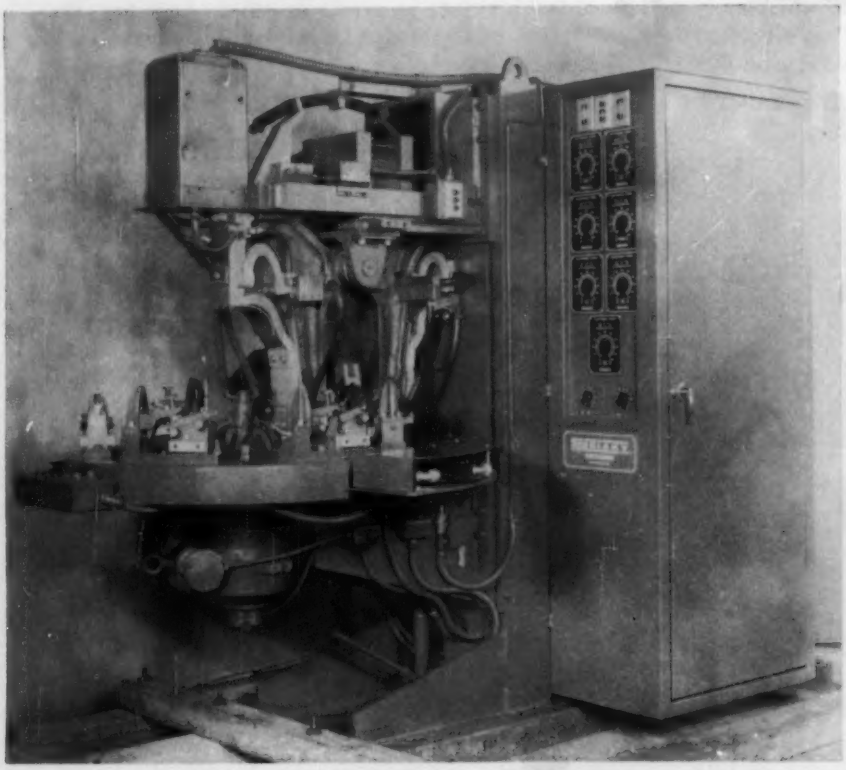


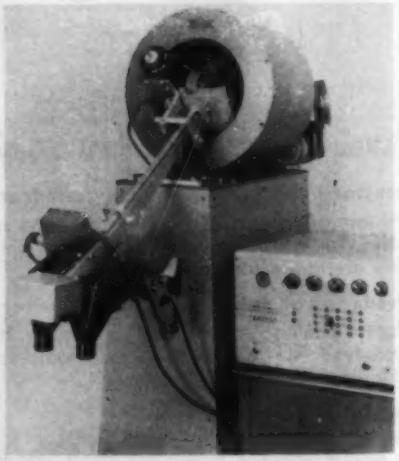
1. ROTARY INDEXING WELDER

Single-phase, dial feed, rotary indexing welding machine is used in production of automobile bumper guards. Welder is equipped with six welding stations for direct welding bumper guard assemblies. With a rating of 150 kva at 50 per cent duty cycle and with an electrode force of 4800 lb at 80 psi, this machine incorporates squeeze, weld, nonsynchronous start, positive positioning and completely independent control of all functions. In operation bumper guard mounting bracket is placed over locating pin where it is held in place by spring hold-down. Hold-down is depressed in loading bumper guard shell. At welding station, both bumper guard and bracket are pressed into final location by air-operated lever arm. Welding pressure is applied by vertical yoke. Both sides of bracket are welded simultaneously. Yoke assembly floats in relation to the table to equalize pressure on both sides of assembly. Two welding transformers are used to supply welding current—one connected to each welding die and return shunt pad. After welding, bumper guard requires minimum of external finishing to satisfy requirements of smooth chrome surface. Machine can produce 1000 completed assemblies per 50 minutes. Unit can weld 0.090 to 0.150-inch mild steel and low alloy-high strength steel. **Sciaky Bros. Inc.**, Dept. M-3, 4915 W. 67th St., Chicago, Ill.

Circle No. **1** *on Reply Card*

2. ELECTRONIC FEEDER

Wide variety of items including nuts, bolts, screws, rivets, dowels, candies, pharmaceutical products, nails, small die castings, bent steel products, etc. are handled by new electronic feeder. Change-over from one size or shape to another can be made in approximately five minutes by means of a few screw adjustments. In one instance machine was used by a bead manufacturer to package beads by count. It fed and accurately counted transparent plastic beads at speeds exceeding 4000 beads per minute. Counting was done by means of an electric pickup head. Any preset count from one to 100,000 can be set by turning dials on predetermined electronic counter, resulting in 100 per cent accuracy. Operation of the feeder is as follows: Hopper consists of cast iron or cast aluminum drum with cast-in pockets. As barrel slowly revolves, articles gravitate into pockets where they are trapped by baffle plate which gradually covers more and more of pockets as pocket approaches highest position of bar-



rel. At top position, baffle plate abruptly ends, allowing parts to flow out of pocket and down a chute. Part way down the chute is a knock-off wheel which rejects those parts which are not properly oriented back into hopper. At end of chute is electric eye which registers number of pieces passing through chute. Actual count is recorded in predetermined electronic counter. At end of chute is housing consisting of two funnel like exits. Exits are separated by means of a gate which deflects parts coming down chute through one of funnels. When preset count is reached, gate snaps over, accurately separating last article of one count from first article of next count. Instrument automatically resets itself and counting continues without interrupting flow. Machine is made in several sizes including 16 and 20-inch diameter drums. Electronic instrument can be provided for maximum counts of 100, 1000, 10,000 or 1,000,000. **U. S. Engineering Co.**, 40-24 22nd St., Long Island City 1, N. Y.

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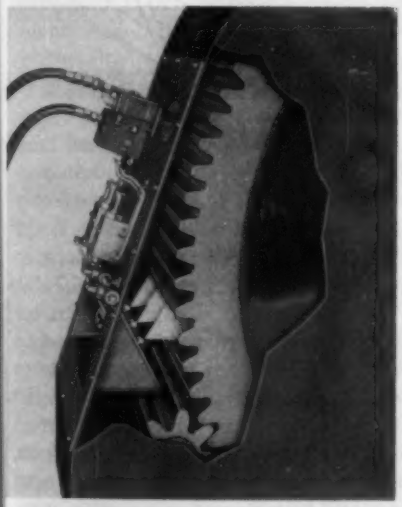
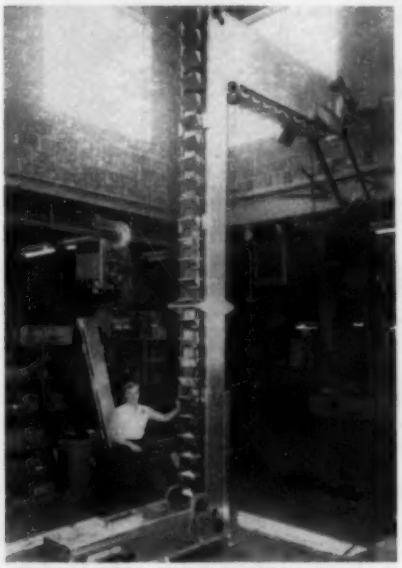


3. SPRAY VALVE PANEL

Bull gears, girth gears on grinding mills and kilns, and other spur or herringbone gear trains are spray lubricated with new device. Illustrated control panel is fastened to gear housing or framework and will spray lubricant directly to pressure side of gear teeth. Measuring approximately 2 by 3 ft, panels feature stainless steel spray valves having built-in nozzles. Central pumping units deliver gear lubricant at regular intervals through circuit of Dualine measuring valves. Measuring valves distribute lubricant under pressure to spray valves where it is mixed with air to form penetrating spray. Results from using new panels include elimination of messy oil conditions, saving of excess oil and reduction in lubricant needed. **Farval Corp.**, 3249 E. 80th St., Cleveland 4, O.

Circle No. 3 on Reply Card



4. BUCKET ELEVATOR

Manufacturers of ball bearings, fasteners, automobile hardware, screws, and many food products can replace batch handling between operations and eliminate manual control of succeeding operations through use of ROBO-LIFT bucket elevating conveyor. Horizontal infeed section, with interlocking buckets, makes possible automatic adaptation of flow of product from preceding operations such as grinding, thread rolling or cake mix blending. A controlled supply of parts or product can then be elevated and conveyed to one or more succeeding operations or stored in conveyor itself and recirculated until needed at one of the next work stations. **Counsel Machine Co. Inc.**, 8 Hathaway St., Wallington, N. J.

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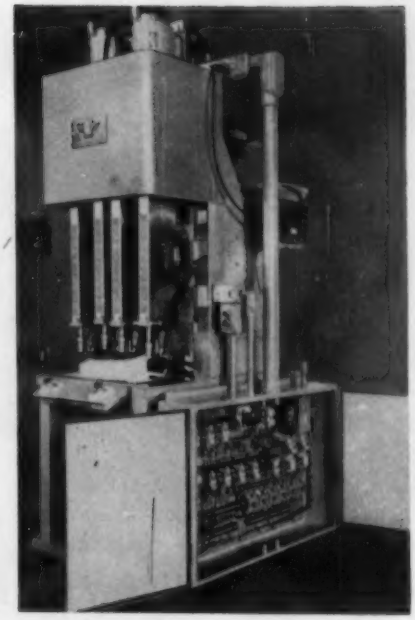

5. STUD DRIVER

Studs can be driven simultaneously at various angles up to 30 degrees from vertical and at heights up to 12 inches above table by new line of universal stud driving machines. One of two available models drives one to six studs; other machine drives up to 12 studs simultaneously. Machine is extremely flexible and all heads can be changed to a new pattern in less than one hour. Vibrating hopper feed sorts and delivers studs to positioning fingers, ready to drive. To compensate for distortion in die cast components being produced, components are clamped in place in an epoxy resin mold by from one to six self-locking hydraulic clamps. Each head is driven by a separate motor with its own interlocking control circuit, and can be made inoperative by disconnection of hydraulic and electric circuits. Machine is operated by two pommel buttons which must be depressed simultaneously. If any motor should become overloaded, entire machine shuts down and panel indicates which circuit is overloaded. Because of the wide flexibility, new stud driving machines are not special purpose but can be used for any production stud driving job and amortized over years of service. **Syracuse Special Machine Co.**, 2900 Erie Blvd. E., Syracuse 3, N. Y.

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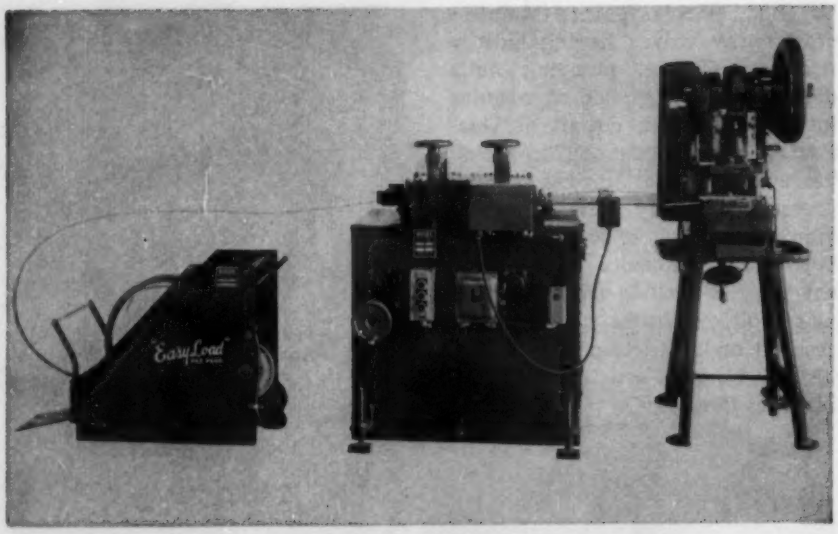

6. STRAIGHTENING AND FEEDING MACHINES

Two models of straightening and feeding machines will produce a maximum of approximately 60 parts per minute, depending upon the length of feed. Straightening and feeding rolls of machines are driven through a Warner electric brake and clutch and controlled electrically to provide automatic feeding of straight stock into a punch press or shear. Standard feed rates of R series are variable from 18 to 95 feet per minute; S series varies from 20 to 105 feet per minute. Maximum width capacities of the R series are 10, 15 and 20 inches, of the S series, 10, 15, 20, 24 and 30 inches. Thickness capacity ratings for mild steel range from a minimum of 0.020 inches to a maximum of 0.190 inches. Machines are furnished with controls arranged for feeding press from left to right or vice versa. Through the addition of casters at one end and a removable lift jack on the other end, machines can be made portable. Machines have seven straightening rolls and four pinch rolls. Pinch rolls and four lower straightening rolls are power driven. All rolls are hardened and ground and mounted on antifriction bearings. Four methods of operation are available with the machines. Feeding into a positive stop in which the feed cycle is originated by momentarily closing the *Start* limit switch either manually or by the upstroke of the press ram is one method. Stock is fed into die against positive stop. This method produces identical parts with no length variations. Another method is use of the feed length selector. This is employed where a variation in feed length is permissible. It is suited for single station dies on jobs which have a scrap skelton between each part. A third method is feeding into the *Stop* limit switch. While this method is suitable for long feeds up to 50 feet or more, the straightener may be located within one or two feet of the press. The fourth method is feeding into a slack loop. A loop control arm can be furnished as optional equipment so the machine may be used as a conventional straightener feeding into a slack loop for operations having an automatic feed on the punch press. **Rowe Machinery & Mfg. Co. Inc.**, Dallas, Tex.

Circle No. **6** *on Reply Card*

7. BRAKE-BAND BOND

An improved automatic transmission brake-band bonding machine for the automotive industry bonds brake linings to steel bands by low voltage electric heating elements. Bonder features one-shot lubrication for entire machine, semiautomatic loading, automatic unloading and easy accessibility to each of its 42 stations. It bonds 360 brake linings per hour. Pressure is supplied from expanding air chuck. Bonder is controlled thermostatically at each station. Machine has positive index control, can be adjusted to time control and can be indexed slower or faster. Bonder continues to operate even if one or more stations are down. Each station on machine acts as a complete unit with its own air cylinder, signal lights and gage. **Distel Tool & Machine Co.**, 2585 Beaufait, Detroit 7, Mich.

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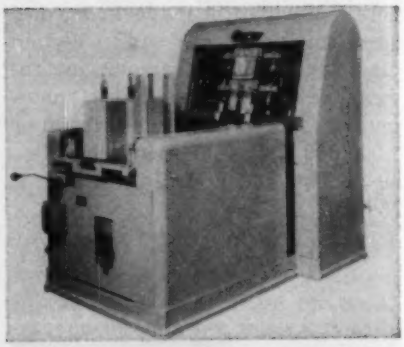
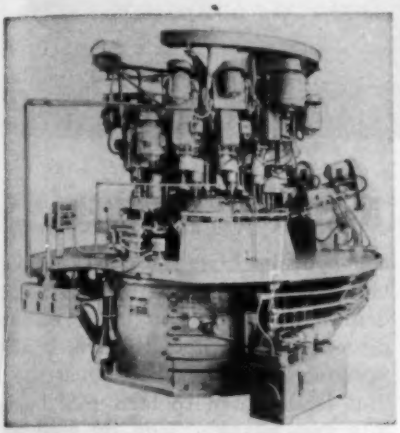


8. GLUER AND FORMER

Fully automatic carton and tray forming and gluing machine produces up to 175 or more perfectly shaped and glued cartons or trays per minute. Model also operates efficiently at lower speeds of 50, 75, 100, 125 and 150 cartons or trays per minute. Improvements enable the machine to handle a wide variety of top opening, hinged cartons or trays for products such as crackers, cookies, confections, frozen foods, cigarettes, fruit and vegetables, drugs, cosmetics, textiles and hardware specialties. Machine is adjustable and convertible to take low cost blanks in sizes from 6 to 18 inches long and from 6½ to 19 inches wide. Operations begin when a simple blank feeding mechanism automatically feeds blanks into machine where glue is applied to end flaps. Clamps grasp cartons securely to prevent slippage, sliding or shifting. Gluing cycle is longer than normal to

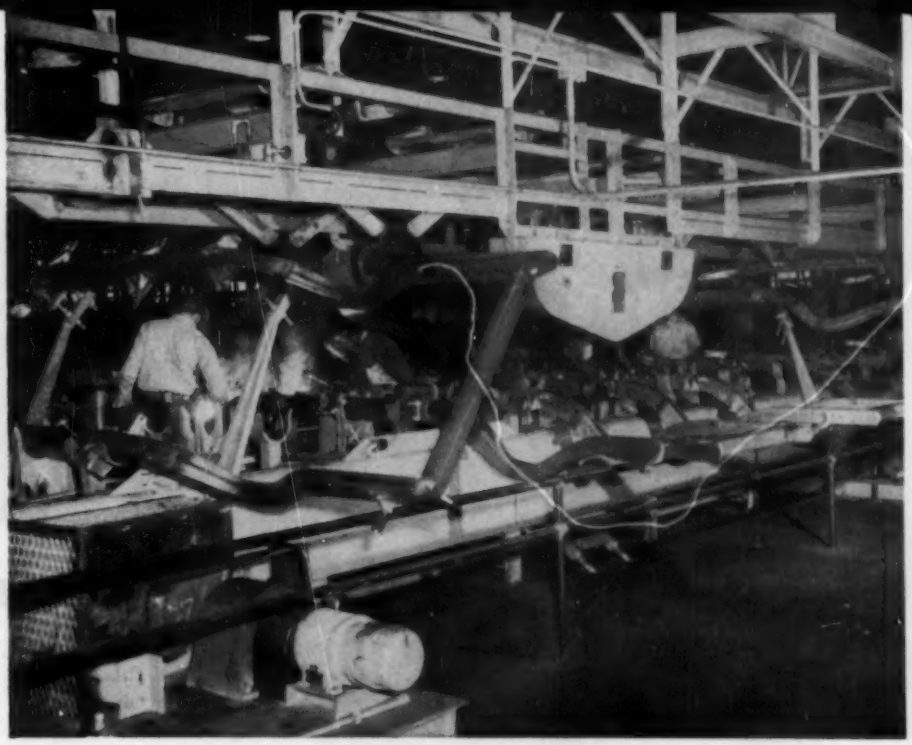
permit glue to set firmly. Cartons come out perfectly squared and formed. Mechanism of machine is easily accessible for cleaning or adjustments. A 1 hp drive motor runs the machine. **Peters Machinery Co.**, 4700 Ravenswood Ave., Chicago 40, Ill.

Circle No. 8 on Reply Card



9. DRILLING MACHINE

Specialized machining with standard units is provided by automatic production machine. Unit machines 375 carburetor air horns per hour. It drills, burrs, reams, taps and spotfaces, performing 24 operations on 21 holes on four perpendicular and one angular face. Unit may be adapted easily for almost any type of product requiring multiple drilling operations on mass production basis. Basic unit of new machine is stationary vertical center column, surrounded by horizontal removable platen. Hydraulically operated indexing table is mounted on central column. Above table, on column and on horizontal platen, drill units are mounted. Indexing table is fitted with air powered clamping fixtures to hold workpieces. Table indexes through 12 stations, where fixtures are automatically indexed and positioned by cams on central column. Machine operator loads unfinished pieces and unloads completed parts. Drill units are oil or air powered, controlled hydraulically. Each unit has independent feeds and speeds, permitting adjustment of individual units without affecting entire machine. Each drill unit is preset for correct alignment, performs same operation with each indexing



New Handling System

increases production while eliminating two lines

In one of the automotive industry's newest plants, production of frames for 1955 models was lagging, even though 6 lines were being used. Then Planet engineers were consulted.

They designed and installed a new frame handling system which exceeds current production requirements, doubling the output of the old-style line. *Now only 4 lines are used.* In addition, quality has been improved.

Here's how the system operates. The component parts of the frame are delivered by trolley conveyor to a frame assembly conveyor where they are automatically positioned for tack welding. The assembled frame is then discharged on to the frame welding conveyor illustrated above.

Here the frames are automatically rotated, 90° at a time so that all finished welding is done on a horizontal plane as the frames move by each welding station. Frames are then automatically conveyed through checking, cleaning, and painting operations.

If you have a production problem, why not consult Planet Corporation engineers? Write or phone today. There is no obligation.

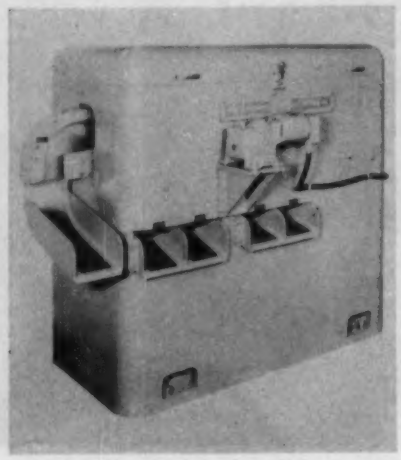
PLANET
CORPORATION
1810 SUNSET AVENUE
LANSING, MICHIGAN

- CONVEYORS
- ENGINEERED SYSTEMS
- FOUNDRY EQUIPMENT
- AUTOMATION
- STEEL FABRICATION

"IT PAYS TO PLAN WITH PLANET"

of machine. All units are controlled simultaneously through integrated electrohydraulic control system. **Morris Machine Tool Co.**, 933-17 Harriet St., Cincinnati 3, O.

Circle No. **9** *on Reply Card*



10. GEAR CHECKER

Automatic motorized precision gear checker is designed to inspect and sort spur or helical gears for three variables in tooth dimensions. Checker inspects gears by electronic indicators and master gear means for incomplete stroke, oversized and undersized teeth and thick or thin teeth. Gears which do not meet inspection requirements for these dimensions are directed into selected chutes which sort out oversized, undersized, thick-tooth and thin-tooth gears. In operation, gears are loaded by hand and fed through various inspection stages in checker automatically. Gears first pass through a set of master gears where they are immediately rejected for incomplete tooth length if they will not roll through. Next, gears are checked for thick or thin teeth and finally for size. Automatic interlocks prevent feeding of a gear through checker until previous gear has cleared the unit. Indicator lights on machine tell operator reasons for rejection of any individual part. Illustrated checker is approximately 31 inches wide, 64 inches long and 4 ft high. Hinged counterweighted cover at top provides easy access to interior of unit. **National Broach & Machine Co.**, 5600 St. Jean Ave., Detroit 13, Mich.

Circle No. **10** *on Reply Card*

11. BOXCAR LOADER AND MATERIAL STACKER

Stacking unit is combined with conveyor to provide a flexible materials handling means. Stacker unit has an adjustable boom which is mechanically raised and lowered through push button controls. Operator has only to guide items into place and swing the boom to right and left as stacking proceeds. Conveyor consists of a drive car, center cars and a power traveler car. Drive car powers the flexible belt. Center cars determine length of unit, as they may be added or removed to adjust overall length. Power traveler car is used to move conveyor back and forth. Flexible belt conveyor bends through a 72 degree horizontal angle in either direction. Rate of belt travel is adjustable to application. Illustrated unit is designed to load rice bags into two boxcars, side by side. It stacks eight bags per minute to a height of 6 ft. Belt is 18 inches wide and overall length is 40 ft. Boxcar loader and material stacker is adaptable to industrial warehouses and other loading applications. **R. T. Sheehan Co.**, Plymouth, Mich.

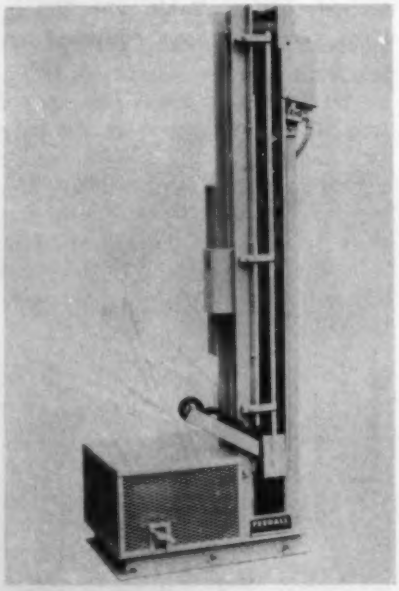
Circle No. **11** *on Reply Card*

12. AUTOMATIC CUTOFF AND CHAMFER MACHINE

Specifications of cutoff machine with automatic bar feed include geared antifriction spindle, double cross slides, special milling slide and tool block, oil feed attachment, auxiliary gage stop to position new bar, and a limit switch to stop the cycle automatically when loading a new bar. Machine has ten forward spindle speeds, from 380 to 1570 rpm, and two automatic spindle speed ranges through the clutch. Bars are loaded into the automatic, air operated bar feed magazine. The end of the new bar is fed to an auxiliary air operated gage stop on the front cross slide. Then the cutoff tool faces the end

of the new bar. The part is gaged to length by a swinging gage stop. While the forming and cutting off operations are being performed, the milling slide advances to support the piece. Tool on rear cross slide chamfers rear end of piece and forms front end of next piece. The piece is cut off and finished parts are fed through a conveyor on the milling slide to the end of the machine. The machining cycle is repeated automatically until the bar becomes too short to make another piece. Then, the magazine stops the cycle, ejects the slug and begins a new cycle by feeding a new bar. **Cleveland Automatic Machine Co.,** Cincinnati 12, O.

Circle No. **12** *on Reply Card*



13. PARTS ELEVATOR

Designed to transfer parts from one operating machine to another, elevating conveyor accepts parts from discharge chute of first machine, elevates and synchronizes them for delivery to next machine. Since both machines are set to operate at same fixed rate of speed, unit operates at same rate of delivery.

New elevating conveyors will handle cylindrical parts up to 3½ inches in diameter and 1½ inches thick. Power is furnished by ¼-hp, 220 to 440-v motor through a variable speed drive. **Feedall Inc.,** Willoughby, O.

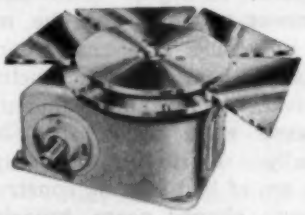
Circle No. **13** *on Reply Card*

Standard 12 stop Intermittor with specially jig-bored 36" dial.

HIGH SPEED INDEX TABLES FOR LARGE VOLUME PRODUCTION

Up to 30,000 Pieces per Hour with

The FERGUSON INTERMITTOR!



Standard 6 stop Intermittor with 12" dial and optional tool mounting brackets.

OVER 150 STANDARD MODELS TO CHOOSE FROM:

NO. OF STATIONS
4, 6, 8, 12, 16, 24, 36

DIAL SIZE
12", 18", 24", 30", 36", 48

INDEXING TIME
¼, ⅓, ½, ¾ of cycle

COMPLETE CATALOG

Every engineer should have a copy of Catalog No. 300 which gives load ratings and all dimensions of more than 150 standard Intermittors. Send for your file copy today... no obligation.

The new standard Ferguson Intermittor is a *must* for operations such as machining, joining, forming, staking, piercing, assembling, testing and inspection that require a combination of high speeds, long dwell or work time, and smooth indexing.

There is a standard Intermittor for almost every application, offering a choice of stops, dial size, degree of movement; and a table for either extreme precision or high torque usage. Seldom do you have so much selection in a line of standard production machinery... with all of the benefits of standardization PLUS many of the advantages of custom designs! The Intermittor operates at speeds far greater than those possible with other types of index tables. The special acceleration characteristics of the FERGUSON ROLLER GEAR DRIVE insure smooth starting and stopping with little shock and vibration, at speeds up to 500 indexes per minute.

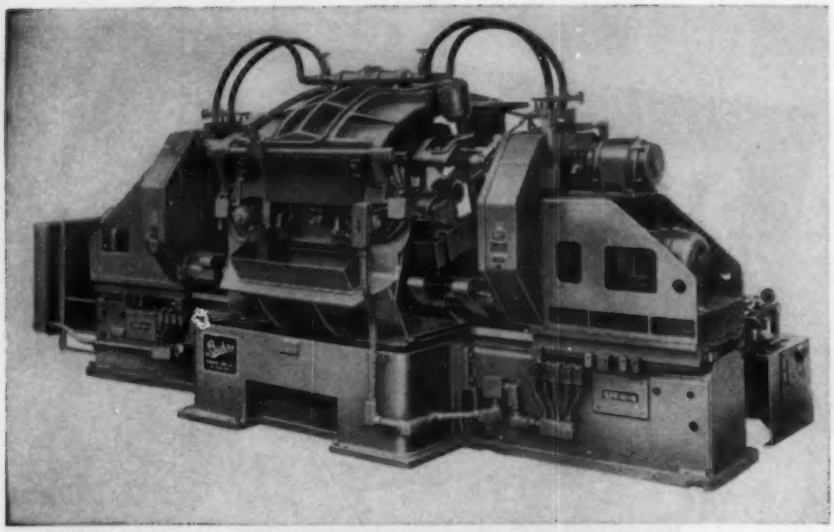
Save design time, simplify tooling, improve product quality and cut maintenance costs to rock bottom with the new Ferguson Intermittor... the "Packaged" precision index table for high speed production.

WRITE FOR CATALOG NO. 300

ferguson

FERGUSON MACHINE & TOOL CO., INC.

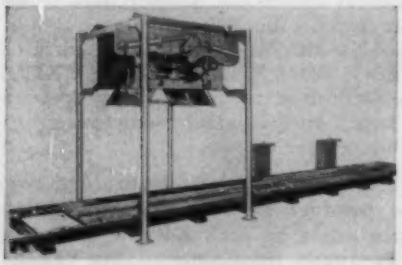
ROLLER GEAR DIVISION, DEPT. AI-1 P. O. BOX 5041, ST. LOUIS 21, MO.



14. TWO-WAY MACHINE FOR ENGINE CRANKSHAFTS

Thirty-four operations on 70 pieces per hour are performed on Plymouth engine crankshafts by new two-way machine. Called the Economatic, machine performs 30 operations from the left side and four from the right. Among features are Powerflo indexing, power clamping of fixtures by means of a power wrench with torque control, and multiple heads of master gear box construction with individual cluster heads. Bushing plates register into fixtures at each station. Thirty operations from left side include, station by station: drill one 27/64-inch diameter hole, one 57/64-inch diameter hole, and seven 7/16-inch diameter holes; face center hole to 30-degree angular seat and drill to 27/32-inch diameter, countersink eight holes; ream seven 0.4533-inch diameter holes, one 0.9085/0.9090-inch diameter hole to depth and one 0.4402-inch hole; countersink one hole to 60-degree included angle. Operations performed on the right side are: drill one 1-1/16-inch diameter hole, spotface one 1⅝-inch diameter hole, counterbore one 13/16-inch diameter hole and form 60-degree seat. Each component assembly of the machine is located by precision-bored dowels. Other features include hardened and ground laminated tool steel ways which are automatically lubricated; multiple heads are of ball bearing construction with shaved gears, broached and splined drives. **Buhr Machine Tool Co.**, Ann Arbor, Mich.

Circle No. **14** *on Reply Card*



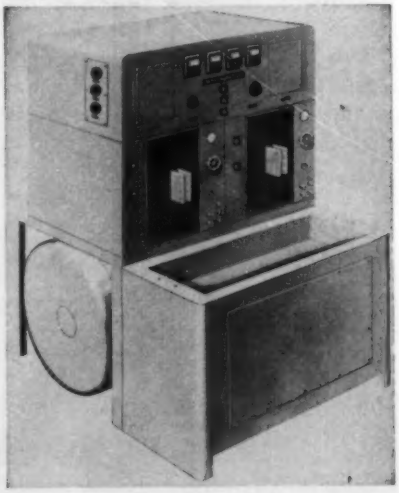
15. LOADING STATION

Coal is handled more efficiently during one phase of its transportation through use of automatic loading station. Station features hydraulically operated fly gate and hopper; either hydraulically actuated "yoyo" clutch or electrical interlocks are provided for use when chain and flight conveyors are being reversed. Controlled loading of cars is accomplished with loading bar, protecting against overfilling either the unit being loaded or oncoming empty unit which receives coal at time of car change. Included in automatic loading station are car body operated valves to secure continuous forward motion at time of change, and also to ensure stoppage of all equipment when final unit has been loaded. **Nolan Co.**, Bowerston, O.

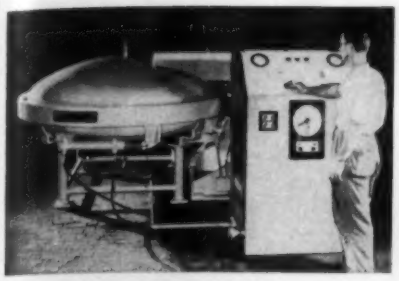
Circle No. **15** *on Reply Card*

16. INDUCTION HEATER

Totally enclosed water-cooled or open air-cooled models are available in induction heat line. Three basic units of heater—30 kw, 10,000 cycle water-cooled set with generator control; high frequency output cabinets; and work table—can be combined 32 different ways to fit numerous induction heating jobs. Flexibility makes unit well suited for hardening and heat treating operations, metal joining, hot heading and forging. Generator control cabinet contains all necessary apparatus for proper control, instrumentation, and protection of high frequency generator. Cabinets are wired for dual operation. High frequency output cabinets are available with 200 or 400v terminals, or equipped to mount a variable ratio transformer or fixed ratio transformer. Detachable worktable provides for mounting a galvanized sink or a bench top. Removable panel below sink makes available space for mounting work handling equipment. Sink is furnished with drain and 3-inch coupling to user's water discharge system. Supporting frame provides mounting for generator control and output cabinets. Overall dimensions of unit are 48 inches wide, 59 inches deep and 77¾ inches high. **Westinghouse Electric Corp.**, P. O. Box 2099, Pittsburgh 30, Pa.



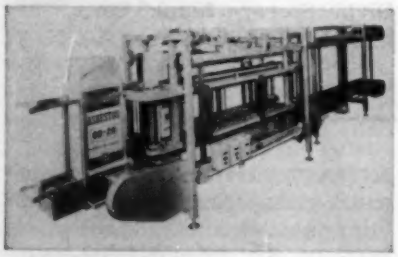
Circle No. **16** *on Reply Card*



17. AUTOCLAVES

Timer, heat control, cycling control, air control, water control, steam control and opening and closing mechanism are completely automatic in new autoclaves. Machines maintain constant preset temperature during cycles and record each complete cycle. Automatic controls give pinpoint accuracy of both heating and cooling, during curing and cooling cycles. Hydraulic operation raises, lowers and locks autoclave lid as required by preset cycle. Silicone rubber gasket gives positive seal and prevents leakage. Autoclaves are used in aircraft industry, cement product manufacturing, rubber, plastics and glass industries. **Philips & Davies Inc.**, Kenton, O.

Circle No. **17** *on Reply Card*



18. BALE SEALER

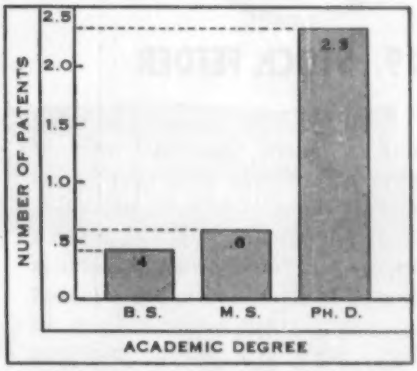
Designed for handling, gluing and sealing of paper, automatic high speed bale sealer can be custom built to almost any bale size and production requirement. Designed originally for handling and sealing of 100-lb bales of asbestos product, machine is now used in numerous other applications. Machine features square tubular framework to afford maximum strength with minimum bulk. Bales are automatically fed from a conveyor in upright position, timed individually into machine, where vertical traveling pushers

SIDELIGHTS ON THE SCIENTISTS *number* **2** *of a series*

How many patents per Ph. D.?

Some of the young fellows on our staff have been analyzing our files of personal data regarding scientists and engineers here at Hughes. What group characteristics would be found?

With additional facts cheerfully contributed by their colleagues they have come up with a score of relationships—some amusing, some quite surprising. We shall chart the most interesting results for you in this series.



Data obtained from a 20% random sample of the 2,200 professional engineers and scientists of Hughes Research and Development Laboratories.

In our laboratories here at Hughes, more than half of the engineers and scientists have had one or more years of graduate work, one in four has his Master's, one in 15 his Doctor's. The Hughes research program is of wide variety and scope, affording exceptional freedom as well as exceptional facilities for these people. Indeed, it would be hard to find a more exciting and rewarding human climate for a career in science. Too, the professional level is being stepped up continually to insure our future success in commercial as well as military work.

Hughes is pre-eminent as a developer and manufacturer of airborne electronic systems. Our program includes military projects in ground and airborne electronics, guided missiles, automatic control, synthetic intelligence. Projects of broader commercial and scientific interest include research in semiconductors, electron tubes, digital and analog computation, data handling, navigation, production automation.

RIGHT NOW *the Laboratories in Culver City, California, and the Missile Production facility in Tucson, Arizona, have positions open for engineers who are experienced in any or all phases of Test Equipment Design.*

SCIENTIFIC STAFF RELATIONS

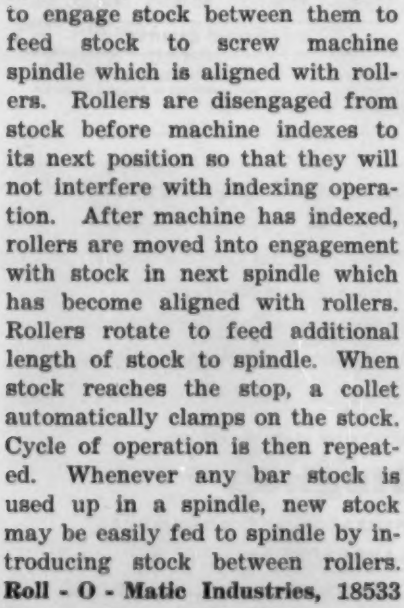
Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

convey bale through back tucking, gluing, second folding and gluing operations. After a bale is discharged from gluing section, it is fed immediately into compression section which consists of top and bottom driven belts over 14-inch wide rolls. Section is intermittently driven by a drive motor separate from the gluer drive. Bale sealer can be conveyor fed from the inlet, and return power or gravity conveyors can be connected to discharge of compression section. **J. L. Ferguson Co.,** Joliet, Ill.

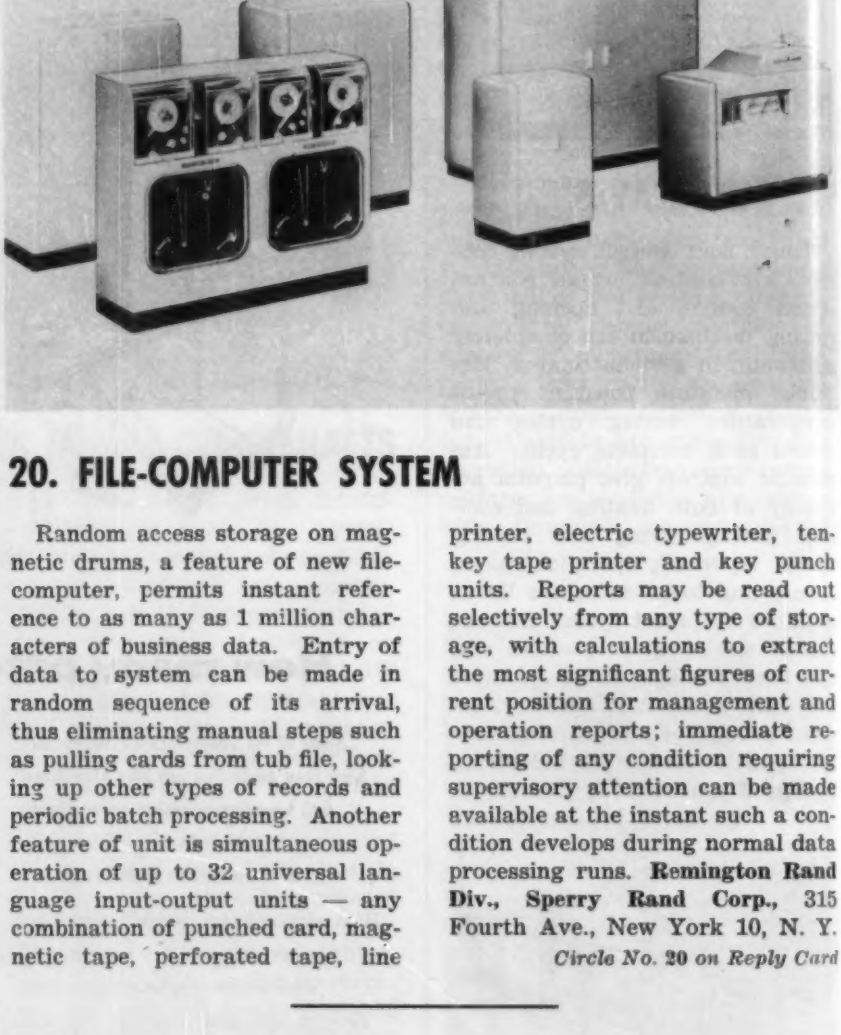
Circle No. **18** *on Reply Card*



19. STOCK FEEDER

Designed to reload multiple spindle screw machine without stopping machine each time previously fed stock is used up, stock feeder eliminates need for feed fingers and tubes. Feeder includes pair of rollers which are adapted to engage stock between them to feed stock to screw machine spindle which is aligned with rollers. Rollers are disengaged from stock before machine indexes to its next position so that they will not interfere with indexing operation. After machine has indexed, rollers are moved into engagement with stock in next spindle which has become aligned with rollers. Rollers rotate to feed additional length of stock to spindle. When stock reaches the stop, a collet automatically clamps on the stock. Cycle of operation is then repeated. Whenever any bar stock is used up in a spindle, new stock may be easily fed to spindle by introducing stock between rollers. **Roll - O - Matic Industries,** 18533 Weaver, Detroit 28, Mich.

Circle No. **19** *on Reply Card*



20. FILE-COMPUTER SYSTEM

Random access storage on magnetic drums, a feature of new file-computer, permits instant reference to as many as 1 million characters of business data. Entry of data to system can be made in random sequence of its arrival, thus eliminating manual steps such as pulling cards from tub file, looking up other types of records and periodic batch processing. Another feature of unit is simultaneous operation of up to 32 universal language input-output units — any combination of punched card, magnetic tape, perforated tape, line printer, electric typewriter, ten-key tape printer and key punch units. Reports may be read out selectively from any type of storage, with calculations to extract the most significant figures of current position for management and operation reports; immediate reporting of any condition requiring supervisory attention can be made available at the instant such a condition develops during normal data processing runs. **Remington Rand Div., Sperry Rand Corp.,** 315 Fourth Ave., New York 10, N. Y.

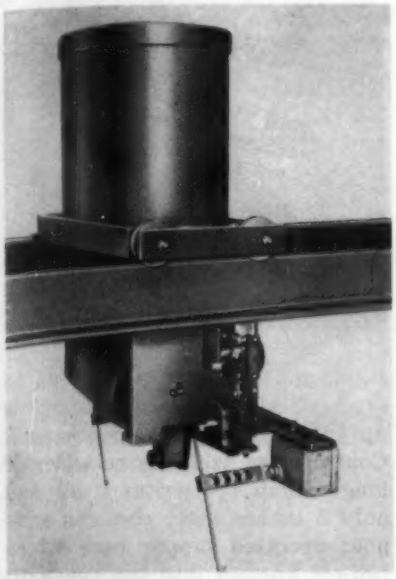
Circle No. **20** *on Reply Card*

21. CIRCUIT PRINTER

Developed for volume production of printed electronic circuits by silk screen process, new press has three basic elements: reciprocating one-piece bed which supports and carries the work reciprocating stencil frame, and a stationary squeegee. Machine has many features designed for efficient silk screen preparation of copper laminated plastic panels prior to etching printed circuits. Bowed panels are held flat by a vacuum. Line contact impression and accurate register give clean reproduction of fine lines. Controlled adjustable inking lays down a thick, uniform layer of resist or flux. Work is hand registered to fixed guides fastened to press bed. During printing stroke work is held flat and in position by vacuum holes in bed. Press will operate either at constant cycle or at adjustable intermittent cycle. Dryer particularly adapted to printed circuit work can be attached directly to press or operated independently. It utilizes a system of greatly accelerated evaporation for high-speed drying of many resists, coatings and inks. Maximum sheet

sizes for press range from 13 by 25 inches to 19 by 37 inches. **General Research & Supply Co.**, 572 S. Division Ave., Grand Rapids 3, Mich.

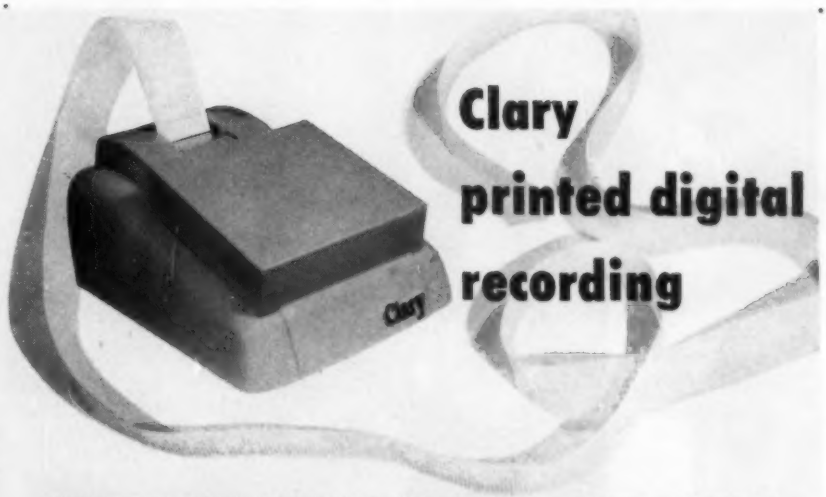
Circle No. 21 *on Reply Card*



22. GLUE APPLICATOR

Featuring a new type of rotary valve, glue applicator automatically meters and applies glue, in precisely controlled thin strips, onto parts or materials which pass beneath it on a conveyor. In operation, leading edge of work material contacts a control lever extending from bottom of unit. Lever actuates a limit switch which energizes solenoid that opens rotary glue valve. When trailing edge of work material reaches control lever, solenoid closes valve, instantly stopping flow of glue. Applicators are adjustable horizontally across work, for desired location of glue strips, and longitudinally for starting or stopping glue flow where desired. Volume of glue flow is also adjustable to insure proper, economical application. Any number of applicators can be arranged side by side in batteries for applying multiple lines of glue, and fountains can be equipped with single or double rotary valves. Designed for high production operations, industrial applications include use in applying lines of glue to wood, fiber, paper, textiles and other materials. **Saramac Machine Co.**, Benton Harbor, Mich.

Circle No. 22 *on Reply Card*



NOW WITH CLARY NUMERICAL DATA PRINTERS you have a *choice* of machines which convert your output to *printed digital recording.*

Now, to solve a wide variety of recording applications, choose Clary models capable of accepting either *serial*-type entry or *parallel* entry. The low cost and extreme flexibility of Clary automation equipment have already made it a prime factor in science and industry—including automatic printing of computers; analog-to-digital converters; scales; digital voltmeters; automatic production devices; electronic counters; inventory systems; temperature and pressure-recording systems; weather observations; laboratory instrumentation.

We also engineer and produce the versatile Clary Input Keyboard, Printing Timer, and other specialized counting and recording equipment. Call or write: Electronics Division, Dept. K 16, Clary Corporation, San Gabriel, California.

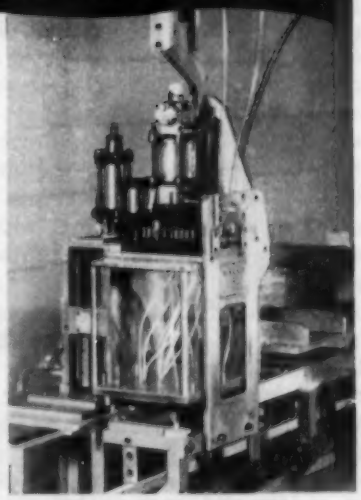
Now... MALCO AUTOMATIC PIN AND CONTACT INSERTING MACHINE FOR PRINTED CIRCUIT APPLICATIONS

...the Most Important Cost-Saving Advancement Yet Offered

Malco's Automatic Pin and Contact Inserting Machine can materially reduce your assembly costs—and at the same time step up production to practically any desired level.

Operation is completely automatic. Up to 40 or more self-retaining terminals are inserted into the printed circuit board in any symmetrical or non-symmetrical pattern within a 3-second cycle. A special platen engages the self-retaining snap-in feature of the terminals, and the board is ready for immediate further assembly and dip soldering.

Malco Automatic Inserting Machines can be engineered to your particular application or production requirements.



Request Bulletin 551. Better yet, give us the facts about your operation. We'll show you how your costs can be lowered and your production increased.

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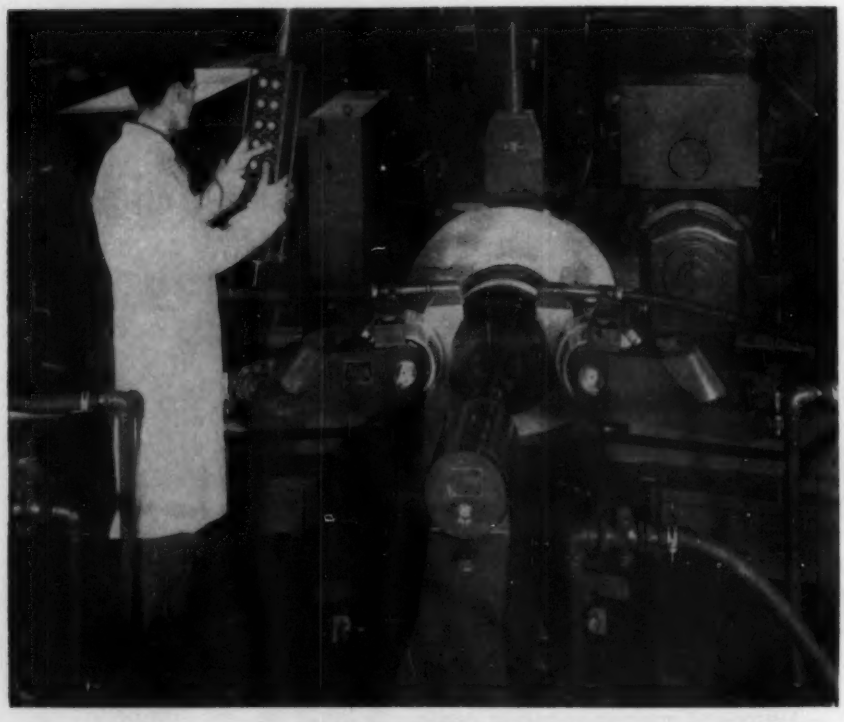


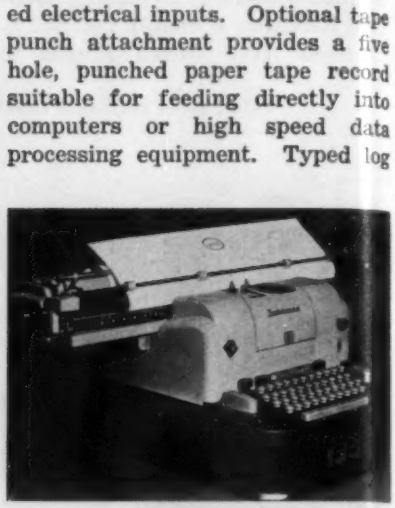
23. AUTOMATIC COLD SPINNING MACHINE

Heavy duty machine for cold spinning cones and tubes is available in a 42 by 50-inch size in plain and duplex models. Called the Hydrospin, machine has the capacity to cold spin regular contoured hollow cones and tubes up to 42 inches diameter by 50 inches long. Roll force, which may result in unit pressure as high as 400,000 psi, is sufficient to roll a ¾-inch flat disk of AISI 4130 steel down to a 60 degree included angle straight wall cone in one pass. Parts may be spun from flat disks, preformed blanks or rings of almost any ductile metal. Hydrospin consists of a heavy welded steel bed which supports the headstock, tailstock and the main slide units. Duplex machine has two main slides; plain machine has one. Tee slots in the bed permit universal positioning of the main slides which support the roller carriers. Hydraulically powered roller carriers are independently controlled and may be traversed simultaneously or individually, depending upon the spinning operation. By placing the slides parallel to each other so that the rollers are opposed, tubes up to 42 inches may be formed. Cones of any included angle may also be formed. Dishing or beading operations on disk-shaped parts may be done. Depending upon the spinning requirements, Hydrospin may be equipped with a 50 to 60 hp infinitely variable speed drive to the heavy duty spindle. Spindle is carried in tapered roller bearings designed to support both radial and thrust loads. High peripheral loads on the 36-inch diameter face plate may be supported through use of an outboard roller mounted on the side of the headstock. Available for use with the machine is a hydraulic contour tracing attachment. With the attachment mounted on the cross slide, parts with curvilinear wall sections or multiple diameter tubes as well as parts having straight sides may be formed. **Process Machinery Div., Cincinnati Milling Machine Co.,** Cincinnati 9, O.

Circle No. 23 on Reply Card

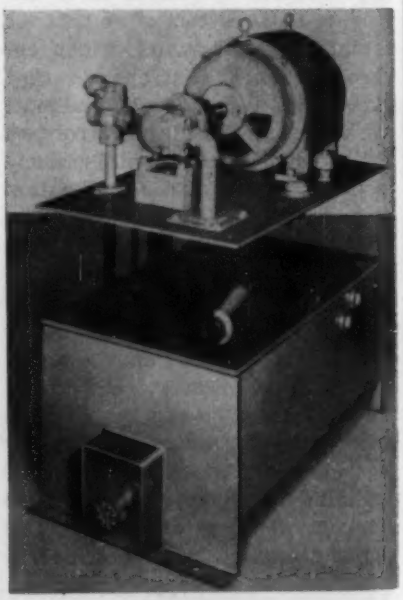
24. DATA TYPEWRITER

Specifically designed for industrial applications, automatic typewriter provides a versatile device for producing printed and punched tape records of mass data in automatic control and data reduction centers. Converted from a standard office electric typewriter, unit permits high speed, remote operation of typewriter keys and typewriter controls in response to coded electrical inputs. Optional tape punch attachment provides a five hole, punched paper tape record suitable for feeding directly into computers or high speed data processing equipment. Typed log



sheets up to 26 inches wide can be automatically produced at speeds up to ten characters per second. Control base, which is no wider or longer than typewriter itself and only 2 inches high, contains solenoid operated tapper bars which project upward into the typewriter. When actuated, each bar trips its corresponding key. System permits remote operation of typewriter numerals 0 through 9, selected letters, and tabulator, space, carriage return and ribbon shift controls. **Fischer & Porter Co.,** Hatboro 35, Pa.

Circle No. 24 on Reply Card

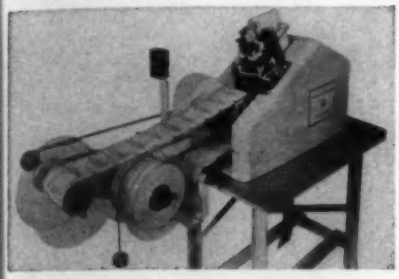


25. HYDRAULIC UNIT

Available in five sizes, from ¾ to 20 hp, line of hydraulic power

units utilizes hydraulic reservoirs from 20 to 100 gal. Electric motors, pumps and necessary valves on hydraulic reservoirs are mounted on units. Reservoirs are equipped with basic accessories—fittings, pipes, filler cap, etc. Packaged hydraulic systems are designed for variety of industrial jobs. **Rosaen Co.,** 24601 Harper Ave., St. Clair Shores, Mich.

Circle No. 25 on Reply Card



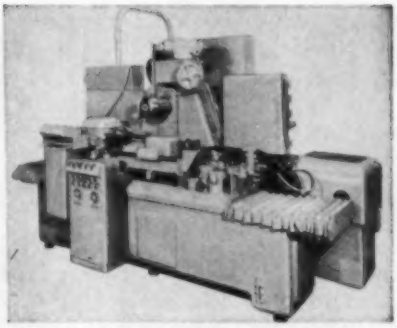
26. LABEL PRINTER

Price, weight, ingredients and similar variable data can be imprinted on die cut roll labels with new machine. Device will imprint a maximum area of 2 by 6 inches on labels up to 4 by 6 inches, at rates from 100 to 125 per minute depending on the label stock being used. Accurate, smooth working pin feed mechanism regulates feed and maintains registration of imprint. Change in label spaceout is accomplished easily by interchanging positive feed unit. Imprinter rewinds labels in rolls, ready for use in label applying or packaging equipment. Imprinting on the new machine is done by solid rubber plates, electros, or master plates with or without removable type for variable data. Fast drying, durable marking compounds are available in many colors for various label stocks. Bakeries, candy and drug manufacturers, food processors and others who package their products will find this device particularly useful. **Markem Machine Co.,** Keene 53, N. H.

Circle No. 26 on Reply Card

27. GEAR GRINDERS

Features of new gear grinding units are automatic loading, rejection, stock equalizing, release of



workpieces, downfeeding and trimming. Machines have controlled flow of coolant through grinding wheel, insuring nontempered, case hardened gears; single or double diamond trimmers which offer good blending of fillet and profile; and multiribbed grinding wheels which increase production rate by increasing number of teeth being ground simultaneously. Other advantages are multiple fixed diamond trimmers which cut down grinding wheel dressing time, and time recorder attachment which accumulates total machine cycle time. **Gear Grinding Machine Co.,** 3901 Christopher, Detroit 11, Mich.

Circle No. 27 on Reply Card

CY-CO-TROL
Tool Control Units

Reduce Production Costs on All Machines with Multiple Tooling!

© Patents Pending

REDUCE YOUR PRODUCTION COSTS

cyclemeters give you positive control of tool life

Keep your machines operating at top capacity . . .

Helps eliminate down-time for machine adjustments . . .

standard and special gages used for all tool lengths

Eliminate trial runs . . .

Reduce your tool breakage and costly rejects . . .

Many of our Units are now in use throughout the Automotive and Metalworking Industries.

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ROYAL design and manufacturing, inc.

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HORIZONTAL BELT CONVEYORS

for:

- production
- assembly
- inspection
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- packaging operations

Standard widths, 18"; 22"; 30" with belt widths 12"; 16"; 24" in 10' exposed belt length. Single units or complete systems to your specifications. May be used as power booster in gravity lines. Let our engineers help you.

METZGAR CONVEYOR CO.

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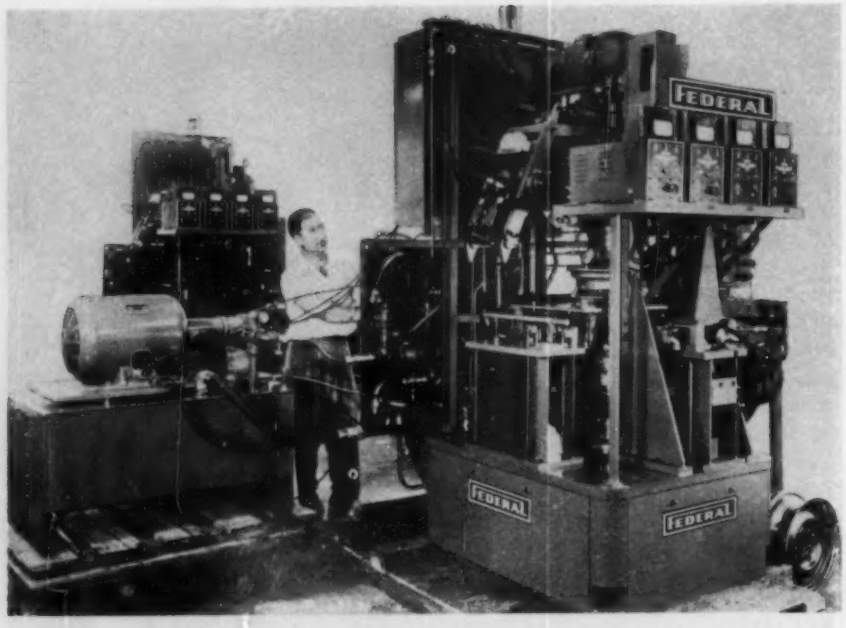
GRAND RAPIDS 4, MICH.



28. RUNOUT CHECKING DEVICE

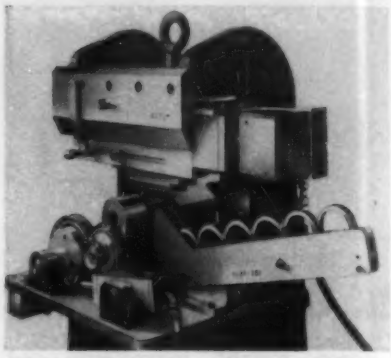
Automatic gage checks tubeless tire wheels for radial and lateral runout by indicating upper and lower bead-seats of rotating automobile wheels. Device is conveyor fed and directs all rejects out of continuous line. Good wheels—within 0.045-inch total indicator reading radial runout and 0.063-inch total indicator reading lateral runout—pass through gage and onto a conveyor which carries them to valve hole punching operator. Two gages are employed in split line which produces wheels for tubeless tires at rate of approximately 900 per hour. Wheels are fed alternately to one gage, then to the other. All wheel handling is accomplished by hydraulic plungers and pistons operated by timing switches. Feeding, gaging and sorting is completely automatic. Gage measures runout by clamping wheel by its five bolt holes with a pressure of 1000 lb per hole and rotating the wheel. This simulates operating conditions of wheel on brake drum. While wheel is rotating, gage-contacts move in and measure runout. Electronic signals are sent to a four-station classifier and if runout is excessive, a disposal trap door is opened. Gaging unit then retracts and gaged wheel is pushed out by a new wheel just entering the gage. **Federal Products Corp.**, 1144 Eddy St., Providence 1, R. I.

Circle No. 28 on Reply Card

29. KEY PUNCH ADDER

New system cables together a Monroe ten-key adding machine and IBM key punch models 024, 026, 041 and 016 to give immediate proof-totals over keypunching. Unit causes numbers entered in adding machine to be automatically key punched into cards. Associated indicative information is entered on the nonadd, appearing in cards and on adder's tape but not disturbing adder's total, eliminating need for further verification in many applications. In other applications, operator may set up a routine in which only the total of an addition, or only totals and nonadds are punched in the card. Another feature of key punch adder system is in automatic cyphering. Attachment has ability to accommodate any field arrangement. Card fields to be filled may contain from two to ten columns each. System will always fill the field regardless of how many digits are placed on the key board, increasing key punch speed and reducing errors. **Systematics Inc.**, Sales Dept., 30 Hermosa Dr., Hermosa Beach, Calif.

Circle No. 29 on Reply Card



30. RACE MARKER

Designed to roll identification on peripheries of bearing races at rate of 1500 to 2500 per hour, new bearing race marking machine is one in line of automatic marking equipment. Parts are fed to chute from turret lathe and are picked up and placed upon arbor which eliminates distortion during marking operation. Arbor recedes, dropping piece into discharge chute. Cycle is timed by Geneva motion, actuated by hydraulic system. Perfect timing prevents jams at marking station. **Geo. T. Schmidt Inc.**, 4108 Ravenswood Ave., Chicago 13, Ill.

Circle No. 30 on Reply Card

31. DATA CONVERTER

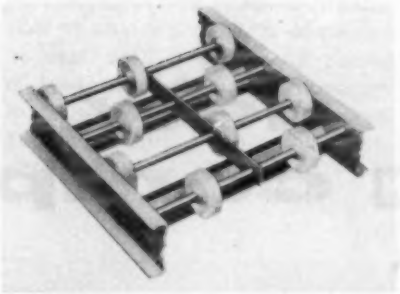
Precision voltage-to-digital and digital-to-voltage conversion is function of data translator. Converter provides two voltage-to-digital conversions per second, or 30 digital-to-voltage conversions per second. Translator includes visual readout and output conversion for direct control of printers, typewriters or card punching equipment. Five decimal digits are provided. Three floating decimal ranges offer full scale readings of

±99.999, ±9.9999, and ±0.99999v, thus providing 10 microvolt sensitivity. **Epsco Inc.**, 588 Commonwealth Ave., Boston 15, Mass.

Circle No. **31** *on Reply Card*

32. LIGHT CONVEYOR

Nylon plastic wheels running on nylon bearings mounted in an aluminum frame are used in new lightweight conveyor. Unit is guaranteed against any weather conditions and to withstand temperatures from 150 F to −10 F. Nylon



bearings are frictionless and must not be lubricated. Conveyor is impervious to detergents, salt water, fruit acid and lactic acid in milk and creamery products. Conveyor is available in standard 12, 15½, 18½ and 24½-inch widths; in 5 and 10-ft straight sections, with 38¼, 61½ and 91½-inch (outside radius) curves. **Metzgar Conveyor Co.**, 408 Douglas St., N. W., Grand Rapids 4, Mich.

Circle No. **32** *on Reply Card*

33. WIRE MACHINE

which can be hand operated for production of small quantities of wire or belt, or motor driven for increased production, straightens and cuts to size short lengths of wire from 1 to 12 inches long and up to ⅛-inch diameter. **Dept. 4K, Lewis Machine Co.**, 3441 E. 76th St., Cleveland 27, O.

Circle No. **33** *on Reply Card*

34. TRUCK CARRIER

is designed to enable 2-wheel hand trucks containing a drum or any other load to be carried on an infloor dragline system. **Dept. R-64, Lewis - Shepard Products, Inc.**, Watertown, Mass.

Circle No. **34** *on Reply Card*

35. MANIFOLD PROCESSING

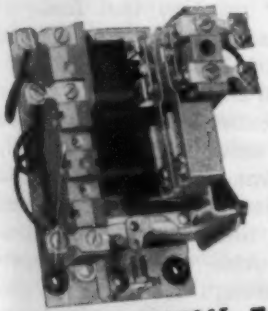
performed by automatic 6-station machine that mills and drills holes in the joint faces of the part and mills and taps holes in the exhaust flange. **Snyder Tool & Engineering Co.**, 3400 E. Lafayette, Detroit 7, Mich.

Circle No. **35** *on Reply Card*

36. CENTERLESS GRINDER

can be provided with automatic loaders for large quantity production of parts by infeed or thrufeed methods. **Landis Tool Co.**, Waynesboro, Pa.

Circle No. **36** *on Reply Card*



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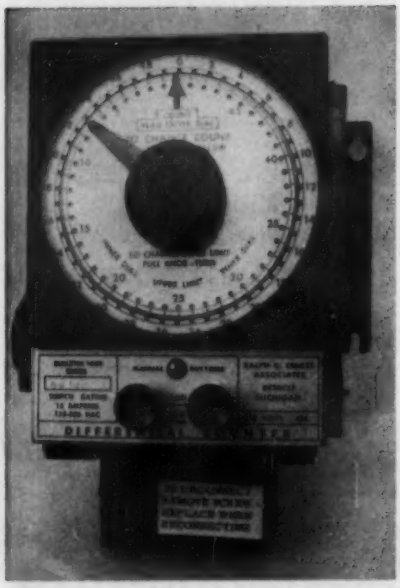


37. Differential Counter

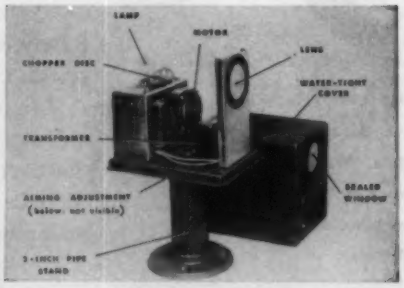
Designed to provide system of count control for conveyors, transfers and machines, differential counter consists of a gear train driven by two continuous duty solenoids—add and subtract, three single-pole double-throw roller type switches, a dial and an adjustable pointer. Two of the switches are adjustable from dial by setting maximum pointer. Other switch is zero switch and operates when dial pointer is at zero count of illustrated outer dial. Counter will record electrical impulses as received by add or subtract solenoid in any combination received; it will also record simultaneous impulses. Counter will operate at rate of 200 per minute. Differential counter has a 4-inch dial, maximum adjustable count of 49, manual push-buttons for changing count, and is arranged for plug-in wiring. Feature of differential counter is that add and subtract impulses may occur simultaneously without count error. Some typical applications of differential counter are as interlocking limit switch, for production control, memory systems, and flow control. Other models with varying features such as higher count, special switches, etc. are available. **Ralph D. Ernest Associates Inc.**, 12818 Puritan Ave., Detroit 27, Mich.

Circle No. **37** *on Reply Card*

38. Electric Eye

Foolproof photoelectric relay saves time and labor, protects equipment, safeguards personnel and forestalls intrusion in industrial applications. Equipment is not affected by any light changes due to sunlight, flashlights, headlights, etc., because it employs a pulsed rather than steady beam of light. Projector consists of low voltage incandescent bulb driven by step-down transformer. Light beam from bulb is interrupted several hundred times per second by revolving disk with holes near its outer edge. Receiver is tuned to this frequency so that it will not be sensitive to steady light or light beams pulsed at any other frequency. Projector has 50 cp, 8v headlight bulb operated at 4v to increase life to over one year. Lens focuses the beam. Gas welded cabinet has bottom tilt adjustments. **Electronic Control Corp.**, 1573 E. Forest Ave., Detroit 7, Mich.

Circle No. **38** *on Reply Card*

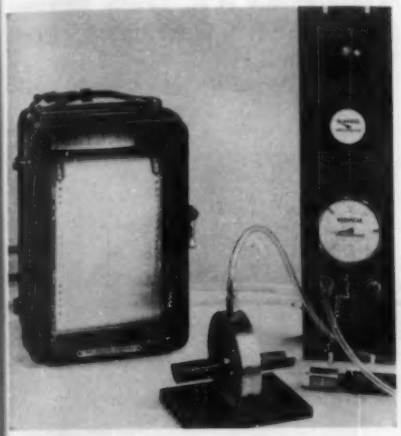


39. Variable Speed Drive

Wide-range adjustable speed drive for machine tool feeds affords speed range of 100 to 1 with continuous electrical speed adjustment with a high degree of stability over entire speed range. Capacity of drive is from ½ to 4 hp. Applications include machines that require continuous speed adjustment up to 100 to 1 and those which provide even higher speed ranges through use of simple gear shifts or ratio changes. Packaged drives with electronic control panels are suitable for mounting and integrating with other machine controls. Drive motors are spe-

cifically designed for operation from electronic control units. All of small electronic components are grouped, wired, and sealed in plastic for complete protection from harmful atmospheres, vibration and shock. Operation of drive requires standard single-phase power. For special feed requirements, drive can be modified to provide extremely close speed regulation by tachometer feedback. **Reliance Electric & Engineering Co.,** 1088 Ivanhoe Rd., Cleveland 10, O.

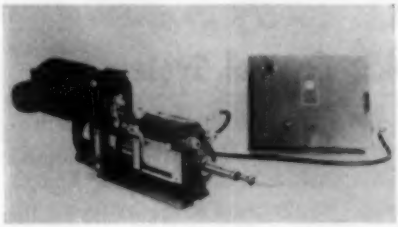
Circle No. **39** *on Reply Card*



40. Air Gage Recorder

Permanent record of workpiece size measurements is provided through use of air gage recorder. Device combines air gage, panel mounted to facilitate installation, with Bristol strip chart recorder. This air gage can be satisfactorily calibrated with recorder because it is accurate enough to have an exactly calibrated, graduated scale. A special gage head is used for continuous measuring of sheet or strip material. Recorder chart provides both a permanent record and a constant visual check of thickness of material. Size trend is easily followed by observing position of line on the chart. When chart shows trend toward out of tolerance dimensions, corrective action can be taken before any scrap is produced. Automatic operation can be provided by addition of other units which will automatically adjust machine to make it produce material of required thickness. Individual measurements can also be permanently recorded, enabling inspector or supervisor to review previous production at any time. Strip chart can be sent with a part as a record of inspection when it is necessary to supply such a record. **Federal Products Corp.,** 1144 Eddy St., Providence 1, R. I.

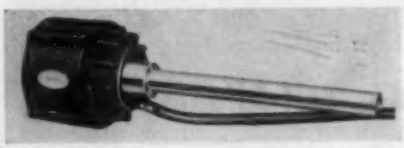
Circle No. **40** *on Reply Card*



41. Reversing Controller

When incorporated as control system for tapping unit, automatic reversing device affords operation of tapper either as a motor reversing type high production tapping unit, or as a production drilling unit. Three-position selector switch on cover provides quick and easy method of selecting desired type of operation. When tapping, reversing of motor is automatically co-ordinated with retraction of spindle through air monitor line connected between control panel and tapper. Air monitor system of control simplifies installation and allows standardization of the set-up procedures for both drilling and tapping. Production rates of up to 30 tapped holes per minute can be obtained when special high reversal type motors are used for spindle drive. Automatic reversing control provides complete overload protection for drive motor to prevent motor burn out. Units are designed for incorporation into special automation type drilling and tapping machines. **Hause Engineering,** Montpelier, O.

Circle No. **41** *on Reply Card*



42. Collet Closer

Automatic or semiautomatic stock holding for hollow spindle lathes and other rotating hollow spindle machines is provided by collet closer. Collets may be opened and closed instantly without stopping the machine. Holding pressures do not vary from piece to piece. Variations in stock size do not affect the action of the device. Collet closer consists basically of a hollow draw bar mounted through the center of an air cylinder. Machine collet, fastened to end of draw bar, is opened and closed by operating the air cylinder. Air cylinder is nonrotating type and exerts closing pressure equal to 25 times air pressure applied. Draw bar permits through-feeding of stock up to maximum of 1 inch in diameter. Collet closer mounts directly to machine head stock. Device may be pushbutton controlled by operator or interlocked with machine cycle for fully automatic operation. **Bellows Co.,** Akron 9, O.

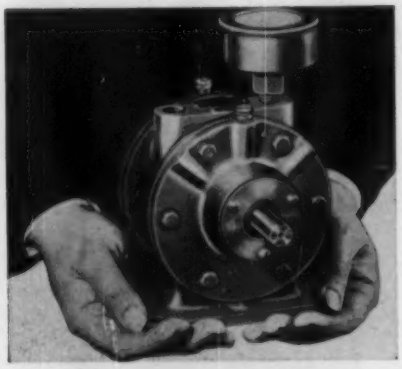
Circle No. **42** *on Reply Card*

43. Pipeless Power Units

Designed to meet requirements of wide range of light-duty industrial applications, such as clamping, indexing and transfer operations, oil hydraulic units feature compactness, design flexibility and manifold mounting of control components. New series of pipeless packages conform to J.I.C. recommendations and include electric drive motors meeting new NEMA frame size specifications. They are recommended for use with systems requiring operating pressures up to 1000 psi. Pumps and valves on new units are directly connected to common manifold mounting panel, eliminating all external pip-

ing on power unit itself and minimizing both maintenance and possibility of leaks. Power units consist basically of an electric drive motor, an oil-hydraulic pump and a control circuit, mounted on an 8-gal reservoir. Reservoir is of optimum capacity for most light duty industrial applications. Three pump capacities are available: 2.2, 3.7 and 5.2 gpm rated deliveries at 1800 rpm and zero pressure. Choice of three electric drive motors rated 1, 1½ and 2 hp at 1800 rpm in combination with three pump options provides flexibility to meet variety of volume and pressure requirements. Choice of three types of control circuits is available with new units. **Vickers Inc.**, 1400 Oakman Blvd., Detroit 32, Mich.

Circle No. **43** *on Reply Card*



44. Compact Air Motor

Weighing only 17 lb, new 2 hp rotary air motor is designed for use on original equipment or for plant use. Motor offers explosion-proof, variable speed power with a simple valve control over a range from 0 to 2000 rpm on air line pressures from 30 to 90 psi. Four light composition vanes slide in rotor, maintaining continuous, efficient seal and taking up their own wear automatically. Motor is constructed to start and run with shaft in any position, and cannot burn out if stalled by overloads. Single shaft extension with counterclockwise rotation is standard equipment on motor; clockwise rotation is available. New motor enlarges line to five sizes ranging from 1/20 to 4 hp. **Gast Mfg. Corp.**, Box 117N, Benton Harbor, Mich.

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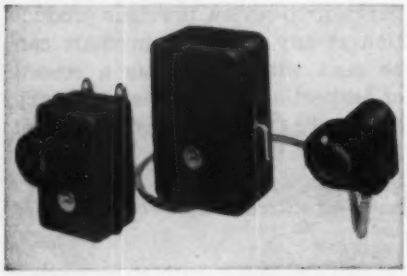

45. Control System

Photoelectric control system provides greatly increased operating distances and high speed operation. It operates over distances up to 100 ft and affords speeds up to 600 operations per minute. Major industrial applications include: materials handling control over long distances, use with mirrors to provide curtain of light protection of large work spaces, operation of wide factory doors, and invisible beam systems for intrusion alarms. Long range protection is provided for personnel working on presses, textile looms, paper and printing machines. Long range set has remote phototube with an extended lens system. High sensitivity assures positive action under widely varying light conditions and interference caused by vapor or dust. Plug-in chassis provides simple installation and minimum maintenance downtime. Relay is actuated on completion of a beam. **Photoswitch Div., Electronics Corp. of America**, 77 Broadway, Cambridge 42, Mass.

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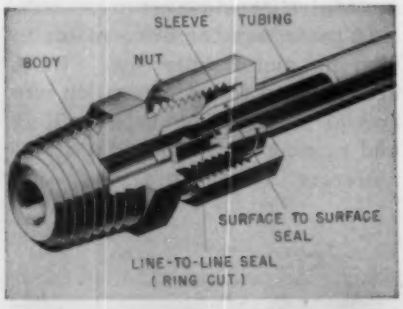


46. Self-Aligning Fitting

Dual sealing principle of self-aligning tube fitting assures positive, leakproof connections. Sleeve grips tubing over broad area for surface to surface seal, while thin razor edge guiding shoulder forms a line to line seal with tubing as nut is tightened. Advantage is that new fitting can be installed without disassembling. Tubing is simply inserted in fitting until it bottoms and nut is tightened. Fitting is suited for instrumentation and all other low and medium pressure applications using copper and aluminum tubing. Complete line includes union, union tee, union elbow, male and female connectors, male and female elbows, male tees for pipe on run and pipe on branch. Sizes ⅛, 3/16, ¼, 5/16, ⅜ and ½-inch in brass are available. **Weatherhead Co.**, Fort Wayne Div., 128 W. Washington, Fort Wayne, Ind.

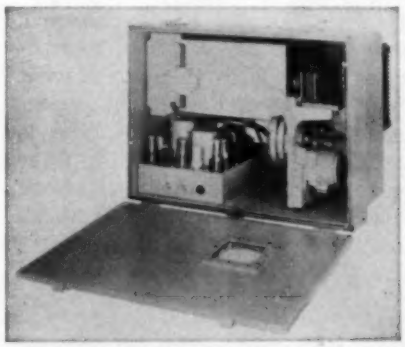
Circle No. **46** *on Reply Card*

47. Position Converter

Position of an input shaft is translated by shaft-position converter into the Gray binary-digital code for use in computers and automatic control equipment employing the Gray code. Feature of Gray code is that only one binary code position changes (from 0 to 1, or vice versa) as the equivalent numerical value changes by one unit. Feature is important in computer and control equipment applications because it assures unambiguous translation of information from the commutator type code disk. The disk connected to input shaft is basic element of shaft-position converter and consists of eight rings of alternately conductive and nonconductive segments, arranged to reproduce Gray binary digital code. Eight rings of disk contain 256 segments, producing a resolution of 2^8, and provide range of coded numbers from 1 to 255. Converter withstands vibration to 10g at 5 to 5000 cycles per second. It is insensitive to

magnetic fields. Typical applications for shaft-position converter include use in guided missiles, fire control systems, automation, and in other systems or devices where it is necessary to convert an analogous value or quantity into purely digital quantities. **Librascope Inc.**, 808 Western Ave., Glendale, Calif.

Circle No. **47** *on Reply Card*



48. Liquid-Gas Analyzer

Instrument for automatically analyzing, recording and controlling chemical processes involving liquids, vapors or gases features accurate automatic recording over many days, without auxiliary attendance. Self-monitoring properties enable photoelectric analyzer not only to record or control a process, but periodically and automatically to check and reset itself to compensate for any smudge accumulation on cell windows or other similar sources of error. Analyzer serves not only as a tool for process control or as an automatic recording analyzer in chemical plants, but equally well in problems involving monitoring and prevention of stream pollution. Aside from its service in liquid analysis, instrument will automatically record quantities of gas or vapor in air, down to a few parts per billion, of such substances as mercury, ozone, naphthalene, benzaldehyde, nitrobenzene, bromine, sulfur dioxide, xylene, and others. Instrument can be set to give an automatic warning of the presence of noxious vapors in the air, or can be used as a system leak detector. **Manufacturers Engineering & Equipment Corp.**, Hatboro, Pa.

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The trip point is adjustable to any point on the scale arc. These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action in contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2½, 3¾ and 4½ inches (all rectangular). Two ruggedized and sealed models, 2½ and 3½ inches (round metal cases). Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland 27, Ohio.

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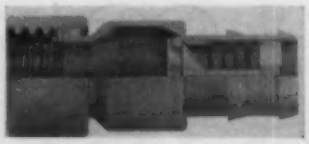
49. Control Panels

Automatic operation of all types of equipment can be made to specification, either for original equipment application or on the job requirements with automatic control panels. Typical examples include use on process equipment, machine tools, microwave equipment, textile and similar machinery, printing presses, sequence operations, warning panels, fuel flame control and load transfer. Panels are compactly built and feature new and improved circuitry specifically designed to insure reliability. Simplified construction provides low initial cost and ready serviceability. Panels are available as open type or enclosed in dust-tight, explosion-proof, water-tight and drip-proof cabinets. Illustration shows panel being used for automatic operation of complete network of oil well pumps. **Industrial Control Panel Co.**, Dept. ANC, 517 W. Monroe St., Chicago 6, Ill.

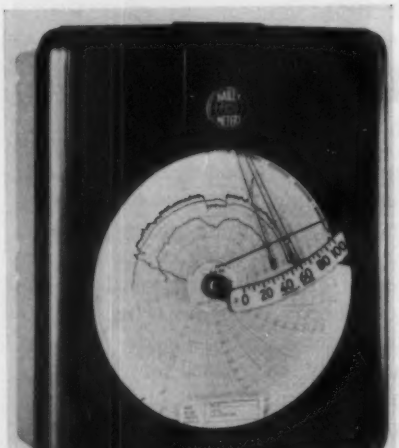
Circle No. **49** *on Reply Card*



50. High Speed Coupler

Designed for rapid transfer of liquids or gases safely and economically, new coupler was originally developed for liquid fertilizer industry to provide most efficient method of transfer, and to allow for high speed filling of tanks from top or bottom. Because solution can be transferred and maintained under pressure, loss of vapor or tank pressure is prevented. Coupler arrangement consists of filler valve that is threaded into tank and coupler for quick connection between hose and filler valve. Filler valve incorporates check valve unit to permit flow into tank and to automatically shut off tightly when coupler is disconnected. One type of coupler unit incorporates an antidrip valve to prevent dripping out of hose when disconnect is made. Alternate type is designed to open valve unit in filler valve to permit draining or reverse flow. **James-Pond-Clark**, 2181 E. Foothill Blvd., Pasadena 8, Calif.

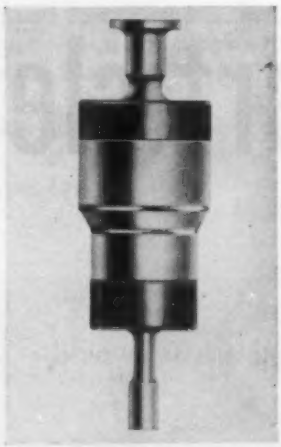
Circle No. **50** *on Reply Card*



51. Four-Signal Recorder

Designed for dc type pickups and dc telemetering systems used in power plants, process plants and laboratories, electronic receiver-recorder eliminates need for individual recorders and special charts. Recorder can house as many as four plug-in dc receivers, or two receivers and two pneumatic controllers. Nonlinearity inherent in many pickups is corrected by a cam at the receiver, making it possible to combine four records from dc pickups, ac pickups, or pneumatic transmitters on same uniformly graduated, circular chart. Unit also conserves panel space, provides equal reading accuracy at any point on chart and improves record analysis. Dc receiver operates on potentiometric null-balance principle, using an electronic voltage reference in place of conventional standard cell and battery. Receiver ranges are 0 to 2 millivolts to 0 to 20v dc. **Bailey Meter Co.**, 1050 Ivanhoe Rd., Cleveland 10, O.

Circle No. **51** *on Reply Card*



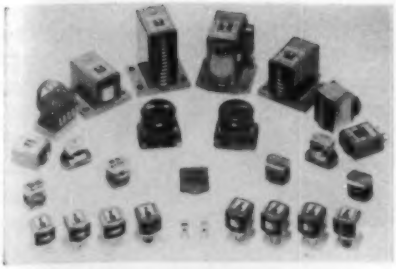
52. Ceramic Capacitor

Designed with a shoulder in the body for mounting instead of an eyelet, ceramic feed-through capacitor can be mounted in small areas or close together on chassis. Self-centering feature prevents tilting. Shoulder holds each unit at the proper distance above ground, so that jigging is unnecessary. Only assembly operations needed are dropping the unit into place and soldering. In lead-through wiring, cupped ends on capacitor speed soldering by serving as solder retainers, keeping solder from bridging insulator gaps. Units are supplied in capacity ranges from 3 to 275 microfarads at ±10 and ±20 per cent tolerances; from 276 to 1000 micromicrofarads at GMV; and are rated at 1000 volts d.c. **Solar Mfg. Corp.**, 46th & Seville, Los Angeles 58, Calif.

Circle No. **52** *on Reply Card*

53. Recording Heads

Feature of magnetic recording heads is molybdenum permalloy laminated pole structure which assures efficiency and low core losses. In single channel heads, each pole tip is lapped to assure



a well defined gap. In multichannel heads, multiple tracks are built up in halves and pole tips of all tracks are lapped at the same time to insure accurate gap alignment between tracks. Single channel heads include several basic designs with a variety of track widths and gap lengths in cartridge and completed assembly form. Featured in this group of heads are half track and full track heads which are used in the professional and semi-professional tape recorder field. Heads are cast in a specially selected resin in a mumetal housing and feature a ¼-mil gap for maximum high frequency resolution. Multichannel heads are available in three basic designs. One series is available with a choice of two to 22 channels, allowing 13 channels per inch of tape or 25 channels on 1-inch tape if the tracks from two heads are interlaced. Another series is available with a choice of two to 14 channels, allowing 8 channels to be recorded on a 1-inch tape. Special pulse head which features five channels cast in a single block of approximately 1 inch in length is also available. **Brush Electronics Co.**, 3405 Perkins Ave., Cleveland 14, O.

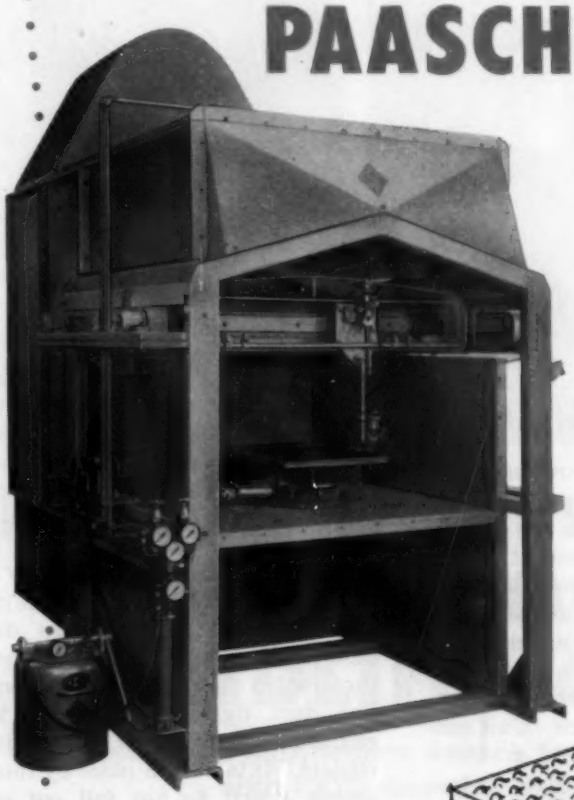
Circle No. **53** *on Reply Card*

54. Selective Pushbutton

Full stroke unit called Select-O-Push is combined with double-pole contact block in new pushbutton accessory. It replaces two single-

AIRPAINT 40 to 85 TRAYS OF JEWELRY-HARDWARE-STAMPINGS or other small parts PER HOUR... WITH THIS VERSATILE

PAASCHE UNIT!



Step up production, improve quality and reduce handling costs in the coating of small parts with a Paasche LLO Automatic Paint Spray Unit.

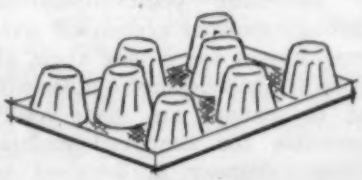
The LLO handles up to 85 (30"x 30") trays of small parts per hour. During automatic processing, the trays are subjected to a unique LATERAL-LINEAL-OSCILLATING paint spray action. Indexing four times at a 90° angle guarantees that all surfaces are uniformly and completely coated.

If you are now coating small parts by hand or other expensive means, write for complete information about the possibilities of the LLO.

IDEAL FOR

JEWELRY

HARDWARE



STAMPINGS

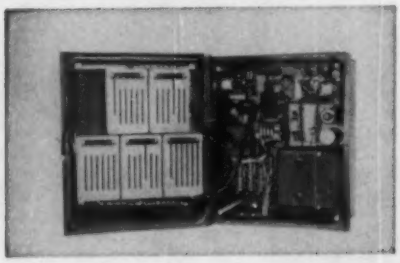
Automatic Spray Equipment For Any Spray Job Since 1904

PAASCHE AIRBRUSH CO

DIVISION OF CLINE ELECTRIC MANUFACTURING COMPANY

pole, double-throw units previously required in many pushbutton applications. Circuit to be energized is selected by dialing operator head left or right. Circuit is closed when pushbutton is depressed. Simultaneous closing of both sets of contacts is impossible. Select-O-Push is designed for use where minimum space is available. **Westinghouse Electric Corp.**, P. O. Box 2099, Pittsburgh 30, Pa.

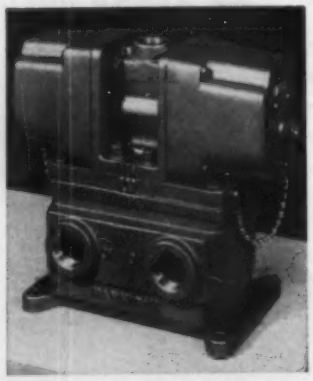
Circle No. **54** *on Reply Card*



55. Electronic Scanner

Checking and controlling various steps in production processes are simplified through use of electronic scanning instrument. Electronic scanner, capable of monitoring up to 25 production points, is designed for use in any industrial or laboratory process to monitor variables including temperature, level, flow and pressure. Unit contains 25 sets of red and green indicating lights on face of instrument, showing step under control and also whether process is functioning properly. Individual control points are set on bank of miniature slide wires. Simple two-wire connection to a recording instrument gives users complete records of process operations. Design characteristics make possible economies in bridging gap from manual to automatic plant operation. Through unusual system of pivot arms, hinges and sliding arms, all decks of components and other wiring in scanner are made easily accessible for simplified maintenance. Scanner is designed to check processes at speed of either one point or five points a second. Unit maintains a continuous check on its own accuracy and operation. In event of breakdown of either component or sensing element, scanner will sound an alarm. It also standardizes its scales automatically and continuously, eliminating need for daily or weekly stoppages for recalibrating. **Fielden Instrument Div., Robertshaw-Fulton Controls Co.**, 2920 N. Fourth St., Philadelphia 33, Pa.

Circle No. **55** *on Reply Card*



56. Air Control Valves

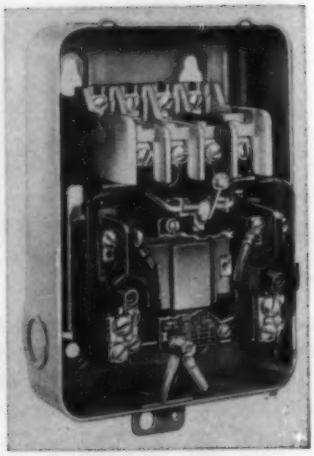
New solenoid heads are the feature of three- and four-way air cylinder control valves. Designed to meet new J.I.C. electrical recommendation that air cylinder control valves be developed which would be electrically inoperative if a maintenance man should remove a solenoid cover and fail to replace it, valves have solenoid covers die cast of zinc alloy and so gasketed that valve becomes splashproof and dust tight. Each cover is chained to valve so it cannot be mislaid. It is held in place by four screws which do not fall out of their holes in cover when loosened. In addition, at end of each cover is a manual operating button which can be operated with small screwdriver or pencil to provide manual operation of valve without removing cover. Operating button is sealed with O-ring so as not to impair splashproof, dust tight feature. Valves are available in three- and four-way designs and in all standard sizes from $\frac{3}{8}$ to $1\frac{1}{4}$. Single-solenoid and double-solenoid models are available. **Hannifin Corp.**, 542 S. Wolf Rd., Des Plaines, Ill.

Circle No. **56** *on Reply Card*

57. Motor Starter Coil

Completely encased within a molded modified epoxy resin, motor starter coil supplies required resistance to combustion, moisture, fungus, temperature and rough handling. Electric starters with dual voltage coils are matched to dual voltage motors. Coil changing is virtually eliminated and stocking of coils and starters is simplified. For example, on 3, $7\frac{1}{2}$, and 10 hp starters, one 220 to 440v electric dual seal coil is used where six are normally required. Protection by fungus resistant epoxy resin adapts this coil to severe temperature changes, high humidity and rough handling. Modified epoxy resin itself is capable of withstanding temperatures of −90 to 250F. **Furnas Electric Co.**, 1128 McKee St., Batavia, Ill.

Circle No. **57** *on Reply Card*

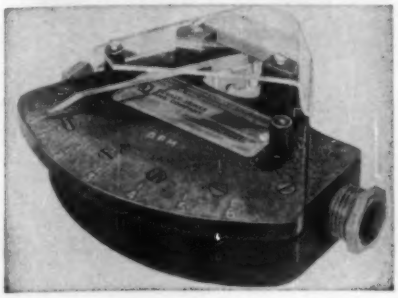


58. Pressure Sensing Unit

Diaphragm pressure switch accurately senses pressure difference from 0 to 45 inches of water between a variable and a reference pressure, with a fixed actuation value of 0.5 inches of water. Reference pressure must be air or an inert gas; variable pressure may be liquid or gas. Switch will actuate an electric circuit on an increase or decrease of a predetermined pressure difference. It can be readily adjusted by means of an external adjustment screw for field setting. Switch is insensitive to jarring or vibration and its

tamperproof external adjustment keeps it from being accidentally disturbed. It will operate in any position—no leveling or special mounting is necessary. Switch incorporates single-pole double-throw snap action switching element rated for ac and dc. **Barksdale Valves,** 5125 Alcoa Ave., Los Angeles 58, Calif.

Circle No. 58 on Reply Card



59. Flow Meters

Direct flow through the meter chamber is feature of new indicating flow meters. Direct flow design keeps housing clean, and flexing of vane in operation prevents any accumulation of scale or sludge. Flow meters are in total flow class so flow eddies due to pipe fittings have little or no effect on accuracy. Basic design improvement made in these instruments is flexible vane riveted to body at one end, leaving other end free to traverse an arc equal in length to calibrated scale. Horseshoe section of flexible vane permits necessary motion under flow, safely within elastic limits of vane. Design eliminates delicate component parts such as pivots, bearings, bellows, diaphragms, glass tubes and floats. Pointer accurately indicates position of vane over calibrated scale. Pointer is coupled to vane magnetically, thus eliminating packing glands, blind bearings, and leakage possibilities. Plastic scale enclosure keeps instrument clean and readable under almost any operating conditions. Because there is no communicating shaft between meter flow chamber and outside, high pressures do not introduce friction due to vane shift or cause lag in pointer. Companion instrument to flow meter is designed with transparent cover to permit viewing liquid or gas flow

CHICAGO TRAMRAIL

TRAK-RAK cuts cost of

BAR STOCK HANDLING 66.3%

employing 2 men where 4 were formerly required . . . with 100% selectivity of material

An improved, simplified, and radically different method of handling bar stock is now in use which replaces the usual difficult and costly method of storing bar stock in pigeon hole racks and removing only a bar or two at a time.

Utilizing the TRAK-RAK Crane System, bar stock is assembled in unit loads placed in containers or baskets which are stored in fabricated tree-type racks on each side of narrow aisles. To remove one or more bars, the container is lowered to the floor, the bars removed and the container with the remaining bar stock placed back in its designated location in the storage racks. The entire movement is one-man, pendant push-button controlled from the floor and it is now possible for the saw man to select his own material and place it directly upon the saw table.

This TRAK-RAK Crane System operates in a 4 ft. 6 in. aisle and stores the material eleven high. The same crane incorporates interchangeable forks which allows the crane to handle palletized material as well as bar stock in the same area.

Write today for TRAK-RAK applications—a 20-page illustrated booklet explaining the TRAK-RAK Handling and Storage System; illustrates and describes installations for handling many diverse materials in fourteen widely different industries.

CHICAGO TRAMRAIL CORPORATION

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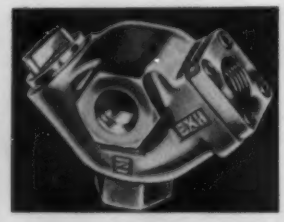
for operations where color changes occur in fluid to indicate oxidation, contamination, waste pick-up or changes in concentration. **Instruments Div., Scully-Jones & Co.,** 1901 S. Rockwell St., Chicago 8, Ill.

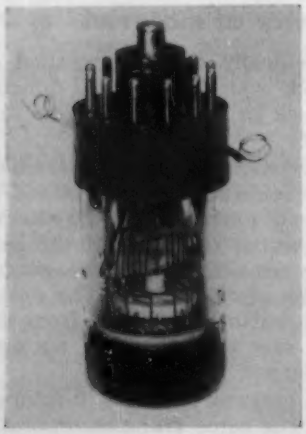
Circle No. **59** *on Reply Card*



60. Quick Exhaust Valve

Feature of quick exhaust valve is automatic opening of oversized exhaust upon reversal of main operating valve, permitting almost instant discharge of exhaust at cylinder. Valve is available in four models with pipe sizes of ⅜, ½, ¾ and 1 inch. Pressure rating is 125 psig; maximum recommended operating temperature is 175F. Valve may be specially used with higher or lower pressures and for operations other than air. **Ross Operating Valve Co.,** 120 Golden Gate, Detroit, Mich.

Circle No. **60** *on Reply Card*



61. Cold Cathode Counter

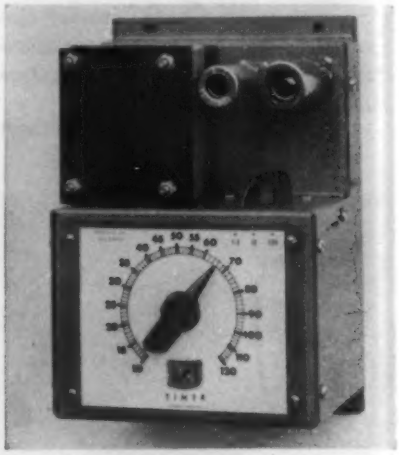
Designed for greater ease and utility in industrial and scientific counting applications, new unit is 12-cathode tube, with all 12 cathodes brought out to pins on the base. Counter has a 13-pin base, plus two extra flying leads. Plug-in base design makes possible applications for glow counting tubes previously impossible with other tube models. Envelope design provides a shorter tube with smooth end face to improve readability. Counting scale of 12 adds to value of device in studies involving dozens, gross, inches, etc., and makes tube a useful divider in many types of timing units. Count is determined by noting position of glow on one of 12 radially spaced cathodes around central anode. When glow is on a cathode, that cathode is positive with respect to other cathodes, making available a positive voltage at any selected count. Operating advantage of tubes is that the count is visually indicated by position of glow in tube, eliminating need for additional circuitry for indicating lights. Tubes are widely used in totalizers and predetermined counters, as well as batch counters where capabilities of mechanical registers are exceeded. **Atomic Instrument Co.,** 84 Massachusetts Ave., Cambridge 39, Mass.

Circle No. **61** *on Reply Card*

62. Stepless Controller

Designed for use with plastic machinery, electric furnaces, kilns or other electric loads, stepless temperature controller modulates the power input to an electric load so that heat input is only equal to heat losses. Modulation is accomplished without use of contactors as used with conventional off-on systems. Stepless controller will vary power input to load between 3 and 90 per cent automatically according to demand. Units are available from 300 va to 100 kva single or three-phase, or in higher ratings. Advantages achieved by this type of controller are prolonged heater life and power savings, adjustable band width allowing units to operate a variety of unstable jobs, and manual reset. The multiload units offer versatility because one unit can be used for several different loads and on either 115 or 230v. **West Instrument Corp.,** 4364 W. Montrose Ave., Chicago, Ill.

Circle No. **62** *on Reply Card*



63. Electronic Timer

Designed for use in automatically controlling operation of various types of electrical and mechanical devices, electronic timer will accurately control duration of time during which an electric circuit is to be maintained either closed or open. Feature of timer is dial which is calibrated in seconds rather than per cent of range. Range of time intervals which can be controlled is 0.1 to 120 seconds. Electronic design eliminates need for lubrication of moving parts and provides split second timing with high degree of repetitive switching accuracy. Possible failure of timer due to breakdown of component part will not trip relay contacts. Safety feature is incorporated to avoid possible hazard of unwanted closing of control circuit which might result in injury to personnel or damage to equipment. **Meg-Electronic,** 1306 Seaman Neck Rd., Seaford, L. I., N. Y.

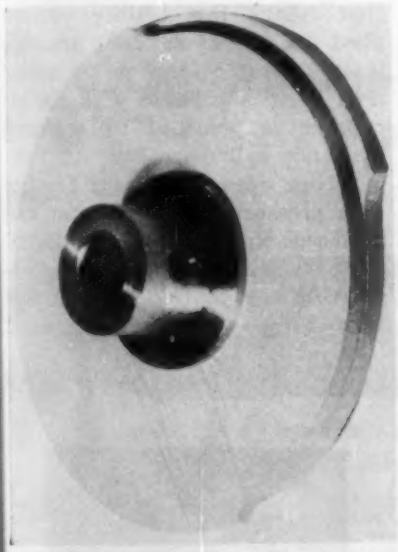
Circle No. **63** *on Reply Card*

64. Magnetic Disk Brake

Designed for use in the 25 to 50 hp range with both old and newly rerated NEMA frame sizes, magnetic disk brake can develop higher torque and yet takes up less space. It requires up to 6 inches less clearance for housing removal than previous model. Overall length has been reduced as

much as 2¼ inches and weight reductions of more than 20 per cent have been made. Two sizes are available which are rated at 125 and 175 lb-ft torque. Brake may also be supplied for floor mounting. **Stearns Magnetic Inc.**, Milwaukee 46, Wis.

Circle No. **64** *on Reply Card*



65. Cam Assembly

Designed to be used where a physical displacement of any limit switch or similar actuating device is required, precision cam assembly has two stainless steel cams which can be rotated with respect to each other and locked at any desired timing position. Stainless steel shaft adapters are designed for three basic shaft sizes—⅛, 3/16 and ¼-inch. Adapters have stainless steel setscrews for holding and subdrill holes for fixed pinning as desired. **PIC Design Corp.**, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

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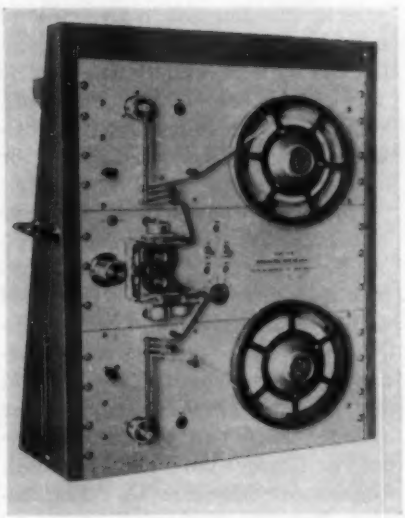


66. Tape Handler

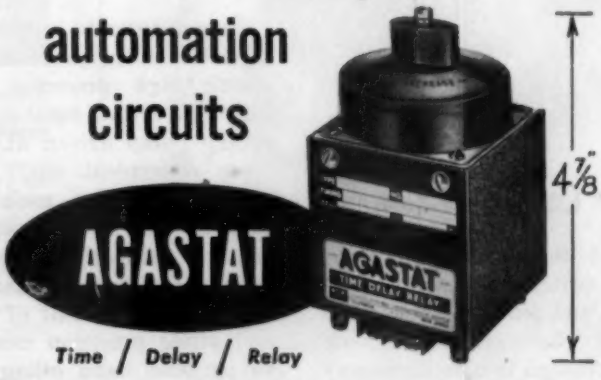
With start and stop times of 5 milliseconds and tape speeds up to 60 inches per second, perforated tape handler offers character readout up to 600 per second. Reader will stop on the stop character at speeds of 150 and 300 characters per second and on the character following the stop character at rates of 600 characters per second. Ability to stop almost instantly eliminates need for any slowing down of handler prior to stopping and thus greatly increases efficiency of machine. Various models handle tape widths from 11/16 to 1 inch and five to eight-channel tape for numerous operations. Handler provides an inexpensive means for intermittent or continuous playback of perforated tape data. Unit can be supplied with character reading speeds of 150, 300 or 600 per second. Servo controlled tape drive provides uniform load tension for fast starts and stops without tearing or spilling tape. Reel size on tape handler is 10½ inches and capacity is 1000 ft. **Potter Instrument Co. Inc.**, 115 Cutter Mill Rd., Great Neck, N. Y.

Circle No. **66** *on Reply Card*

67. Rapid Sampling Switch

Low level, thermocouple or strain gage, high speed sampling switch has five poles with 90 contacts per pole. It features dynamic phase adjustment for maximum convenience and increased accuracy, and a separate semimolded contact plate for each pole. Average dynamic contact resistance

Time delays in automation circuits



AGASTAT

Time / Delay / Relay

When automatic machinery and circuits must be timed with repetitive accuracy (from 0.1 second to ten minutes or more) you'll find a sure, reliable answer in AGASTAT electrically-actuated pneumatically-timed time delay relays.

The AGASTAT is
- light, versatile, dependable.
- unaffected by voltage variations.
- instantaneous recycling.
- available in models which offer delays on energizing and de-energizing, two-step delays, manually-actuated time delay switch, remote push button control.

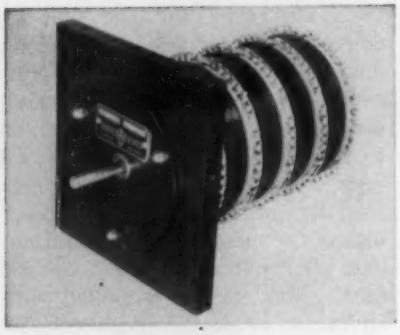
WRITE our application engineers for help with your timing problem. Address Dept. A23-123.

AGA DIVISION

Elastic Stop Nut Corporation of America

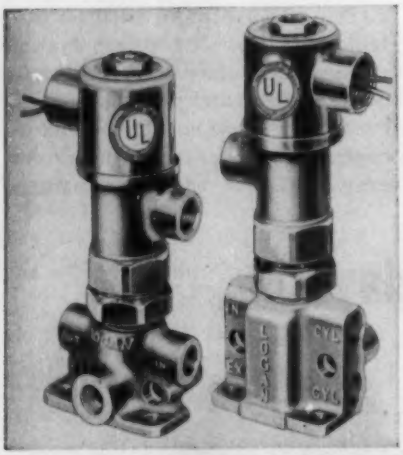
1027 Newark Avenue, Elizabeth, New Jersey

Pioneers in pneumatic timing.



is approximately 1 ohm. Unit is 3⅝ inches in diameter by 6¼ inches long, plus mounting bracket. Available models include single or multiple-pole units featuring stacked, opposed, concentric, raised contact, segmented, and/or printed circuit designs. **General Devices Inc.**, P. O. Box 253, Princeton, N. J.

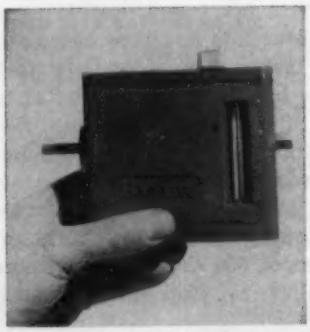
Circle No. **67** *on Reply Card*



68. Air Control Valves

Designed for electric pushbutton, limit switch, or timer control of bleeder and pilot operated master valves. Solenoid bleeder, air cylinder-actuated two or three-way valve is available in side or base mounting. By removing plug in lower port, two-way valve can be converted into a three-way valve. Varnish impregnated coils for 115 or 230v, 50 or 60 cycle ac continuous duty operation are standard equipment. Other voltages and cycles, including dc, as well as molded waterproof, fungusproof or high temperature ceroc wound coils are also available. Second model in line, a dual control, two-way valve, is same as first type except that it has two exhaust openings which permit bleeding at both ends of master valve alternately, providing automtic reversal when electric current to solenoid is shut off. Third model, a four-way, two-position valve, is designed for side or base mounting, and is electric pushbutton, limit switch or timer controlled for operating double acting air cylinders. Maintained contact of control switch is required to direct air flow out lower cylinder port. Release of switch interrupts electric current to solenoid and directs air flow out upper cylinder port and exhausts cylinder at lower port for reversal. **Logansport Machine Co.**, Logansport, Ind.

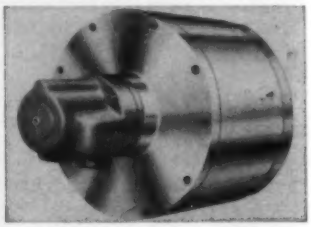
Circle No. **68** *on Reply Card*



69. Automatic Lubricator

New automatic lubricator is designed to solve problems of lubricating high precision machines. Through use of constant pressure rotary pump driven at 1800 rpm from convenient shaft or direct motor, lubricator maintains continuous oil film of constant thickness on critical bearing surfaces. Unit eliminates two major problems: rise and fall of tableways and other precision bearings due to periodic hand oiling or cyclic lubrication, and constant dripping of oil that occurs with high volume flood lubrication systems. Lubricator maintains boundary film of oil at constant pressure, thus eliminating objectionable film variation and excess oil drip. Pressure of 20 psi is maintained by lubricator throughout distribution system of standard Bijur tubing and at lubrication points. Compact system is designed for use on equipment which must work to very close tolerances, and all elements can be fitted neatly into such machines without interfering with their operation in any way. Lubricator is particularly useful on machines operated under constant temperature conditions where oil viscosity and flow can be closely controlled. **Bijur Lubricating Corp.**, 151 W. Passaic St., Rochelle Park, N. J.

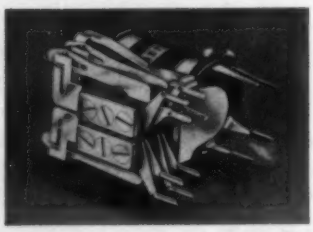
Circle No. **69** *on Reply Card*



70. Rotating Cylinder

Used to automatically provide axial movement to mechanisms that rotate, this cylinder is applied to machines and machine tools. Greater force in a smaller area than is possible with an air cylinder is provided by rotating hydraulic cylinder. Built in various bore sizes, it is rated for use with pressures up to 750 psi and at speeds up to 3000 rpm. Cylinder is made of alloy iron and is balanced for high speed use. **S-P Mfg. Corp.**, 12415 Euclid Ave., Cleveland 6, O.

Circle No. **70** *on Reply Card*



71. Printed Circuit Relay

Miniature relay for direct plug-in use in printed circuits is designed to permit direct insertion of relay terminals into printed circuit board, ready for immediate soldering. Plug-in terminals, instead of being brazed or welded together in sections, have been made integral parts of coil terminals and contact springs to prevent internal loss in conductivity or continuity. Two contact arms of relay permit two spring pile-ups of up to nine

springs each. Relay has been designed for maximum ruggedness with special, heavy duty bearing and bearing pin, and for resistance to vibration, humidity and extremes of temperature. Recess in bearing plate provides sufficient lubricant for long term lubrication of bearing pin. Tests indicate printed circuit relay is capable of more than 100,000,000 operations without readjustment or relubrication. **Automatic Electric Sales Corp.**, 1033 W. Van Buren St., Chicago 7, Ill.

Circle No. **71** *on Reply Card*

72. Compact Brake Motor

Built to rerated NEMA specifications, compact brake motor features usefulness of quick stops and positive holding, as well as a through shaft extension for hand cranks, tachometers or other accessories. Direct acting magnetic disk brake is used which can be connected either directly to motor terminals or to separate power supply. As safety measure, brake will set and hold in case of power failure or low voltage by means of mechanical spring action. Ratings are from 1 to 30 hp. Motors are available with standard, undersize or oversize brakes. Deflectors in motor direct air and deflect water. Two-way ventilation insures uniform cooling of windings and bearings. Lubriflush lubrication permits complete purging of grease from bearings. **U. S. Electrical Motors Inc.**, Box 2058 Terminal Annex, Los Angeles 54, Calif.

Circle No. **72** *on Reply Card*

73. Pressure Switch

Designed for water systems, low-pressure air compressors, paint sprayers and similar applications requiring 1 hp or less, new pressure switch is small enough to fit

in the palm of a hand. Switch has a capacity of 65 psi. Normal pressure settings are 20 to 40 lb, the standard for home water systems. Construction features of the switch include three types of enclosures, adjustable pressure settings, ample wiring room, recessed terminal connectors, corrosion resistant parts, and positive snap action. Switch mechanism generates an initial contact pressure five times that of the control spring. **Furnas Electric Co.**, 1128 McKee St., Batavia, Ill.

Circle No. **73** *on Reply Card*

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30229 GROESBECK HWY., DEPT. A.
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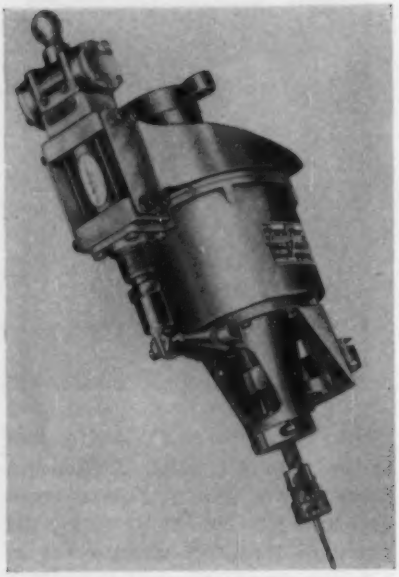
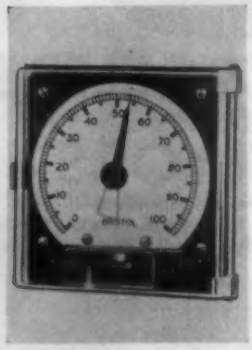


74. Tapping Head

Fully automatic or semiautomatic lead screw tapping on any drill press is possible using new line of Auto-Tap heads. Tapping heads use standard Bellows air motors and Electroaire valves for activating the clutch mechanism. Although a fixed return limitswitch impulse completes the cycle, the starting impulse can be arranged to suit the user's needs. Tap breakage and work spoilage are reduced because the lead screw takes all end thrust and guides the tap. Positive mechanical depth control permits blind holes to be tapped. **Automatic Methods Inc.**, 965 W. Grand St., Div. 228A, Elizabeth, N. J.

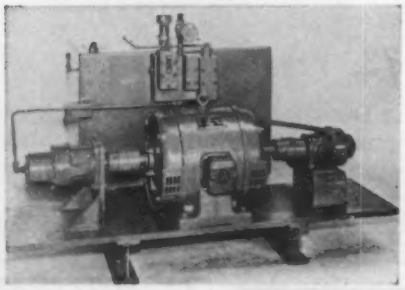
Circle No. **74** *on Reply Card*



75. Miniature Receivers

Designed for use in graphic panel arrangements, miniaturized telemeter receivers are available either as indicators or strip chart recorders, and occupy a panel space of only 5 square inches. Indicators and recorders can be used to receive telemetered signals or any of the usual variables such as pressure, flow, temperature, differential pressure, and such electrical measurements as voltage, current and power. They are identical in appearance to standard pneumatic transmission instruments for short distance transmission of measurements, and thus provide for uniform appearance in graphic panel presentation, as well as in conventional instrument panel arrangements. Miniature receivers use same time impulse duration mechanism as full-size models. **Bristol Co.**, Waterbury 20, Conn.

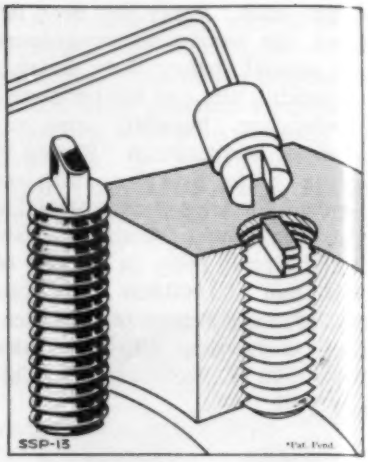
Circle No. **75** *on Reply Card*



76. Hydraulic Units

Oil passages drilled in a steel block eliminate up to 40 ft of exposed piping in electrically driven hydraulic power units and presses. New type of hydraulic circuit is designed to reduce incidence of bursting hydraulic lines; it also results in generally higher standards of efficiency for hydraulic control equipment. Important part of hydraulic system is open drip-proof electric motor, manufactured by ACEC Electric Corp. Features of motor include additional internal turbine type fan for cool operation, even under heavy loads. Illustrated motor has double ended shaft for driving a two-pump unit. Pressures up to 10,000 tons are developed by units with motors up to 50 hp. Hydraulic presses and power units are used by fabricators of steel and nonferrous metals for coining, drawing, forging, forming and stamping operations. **Clifton Hydraulic Press Co.**, 287-293 Allwood Rd., Clifton, N. J.

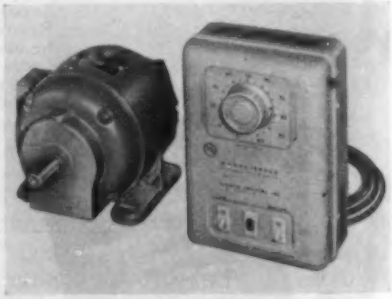
Circle No. **76** *on Reply Card*



77. Locking Set Screw

New development in self-locking set screw is designed to cover applications in which the slab portion of slabbed head set screws cannot extend beyond tapped hole. Positive locking action is effectively retained in all positions. Being flush with surface, screw becomes tamper proof as well as resistant to accidental removal. Set screws are made with undersize slab to permit flush insertion, making it possible to set the screw to same holding power as equivalent size socket screw. Screw can also be supplied in new design, offering holding power advantages of 42 per cent sharper angle. It is suitable for hopper feeding with company's patented mechanism, making possible up to ten times faster application. **Set Screw & Mfg. Co.**, 266 Main St., Bartlett, Ill.

Circle No. **77** *on Reply Card*

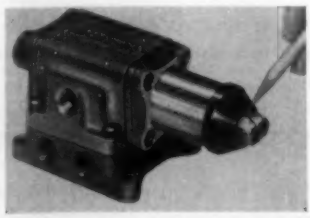


78. Variable Speed Drive

Two sizes of variable speed drives cover a range from ¼ to ½-hp. Drives feature stepless instant starting, no electronic components, compact design, 50 to 1

speed range with good regulation using simple circuitry, fast response and low cost. Reversibility, dynamic braking, local or remote control may be specified. Additional feature of drives is their extreme simplicity which provides for installation without special tools or wiring. **Magnetic Amplifiers Inc.**, 632 Tinton Ave., New York 55, N. Y.

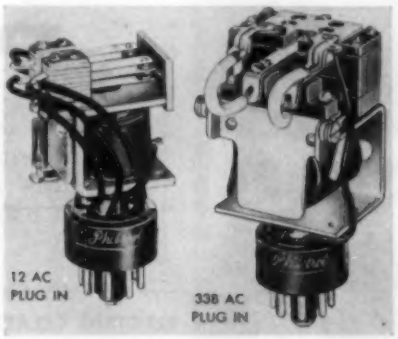
Circle No. **78** *on Reply Card*



79. Heavy Duty Cam Valve

Larger cam roller and cam plunger give increased bearing surface and longer life in new heavy duty cam valve. Plunger spring is loaded to take care of overtravel on stroke and all working parts are completely sealed by means of synthetic boot. Designed especially for foundries, it is well suited for any applications where sand, dirt or dust are present. Valve is available in ⅜-inch, four-way model or in ⅜-inch three-way model. **Mechanical Air Controls Inc.**, 10030 Capital, Oak Park, Detroit 37, Mich.

Circle No. **79** *on Reply Card*



80. Plug-In Relays

Designed to meet the growing demand for convenient plug-in type relays, two new plug-in models have been added to line. One model is general purpose power relay available in either ac or dc, two-pole, three-pole or five-pole types. Other is smaller type relay available in ac or dc for operation up to 230v. **Phillips Control Corp.**, Joliet, Ill.

Circle No. **80** *on Reply Card*

81. Hydraulic Symbols

Cut-outs which depict J.I.C. standards of industrial hydraulic symbols are presented on template for use on design drawings of hydraulic systems. Board is made of 0.030 matte finish plastic; all cut-outs are precision milled. Size of template is 4½ by 7 inches. **Rapidesign Inc.**, Box 592, Glendale, Calif.

Circle No. **81** *on Reply Card*

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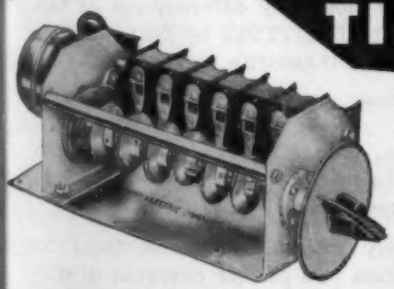
ZENITH Multi-Circuit CYCLE TIMER



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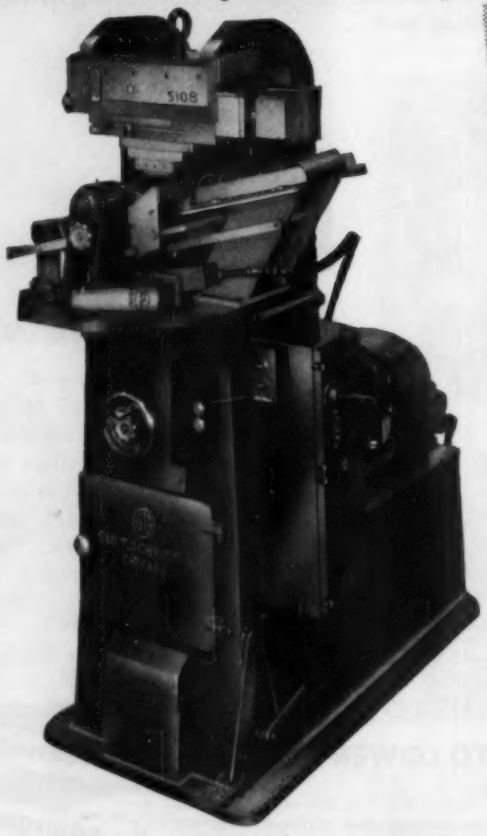
WOW AUTOMARKING

for faster, more uniform, less expensive identification of products and parts



The tube marker shown here, designed and built for a large automotive manufacturer, is a marvel of modern production efficiency. Tubes are given uniform and accurate identification, with a speed that lowers the cost-per-impression to a minimum.

2500 to 3000 Parts Per Hour

This JIC hydraulically-operated machine rolls a trademark and part number on mild steel thin walled tubes at a rate of 2500 to 3000 per hour, depending on length of marking.

Fully Automatic

A Geneva-type feeding mechanism receives parts from preceding operation and deposits them in a rotating spider. A retractable arbor supports parts during marking, after which spider carries them to discharge chute. Operation is *fully automatic*. Machine will not start marking cycle without work at station. Hydraulic action insures clean marking of uniform depth.

GTS engineers have designed many such Production Marking Machines for industry. They reduce marking costs to a fraction of those involved in old fashioned methods. GTS sales engineers will be happy to call and confer with you on your specific problem.

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AUTOMATION patents

Copies of patents are available at 25 cents each from the Commissioner of Patents, Washington 25, D. C.

Components

ELECTRIC DELAYED-ACTION SWITCHES

Delayed-action switch incorporates a spring-actuated motive mechanism which is retarded by an escapement mechanism as long as an electromagnet is energized. Patent 2,719,887 by Alfred M. Allen, assigned to Rotax Ltd., London, England.

LIQUID LEVEL INDICATOR

Variable liquid level is indicated by an energized neon tube near the container. A magnet carried on a float supported by the liquid disturbs the light line in the neon tube. Patent 2,720,785 by Robert K. Sedgwick, assigned to American Steel Foundries.

SHOCK AND STATIC PRESSURE DISCRIMINATING SWITCH

Switch is comprised of a housing, a deformable plastic element and an insulating plug bearing contacts which may be closed by deformation of the plastic element. Patent 2,721,913 by Raymond C. Kent Jr.

• • •

Controls

REMOTE CONTROL SYSTEMS

System alternately modulates and restores to unmodulated condition two carrier currents of different frequencies until a predetermined number of selection steps have been completed. Patent 2,717,986 by Robert P. Dimmer, assigned to Automatic Electric Laboratories Inc.

CONTROL SYSTEMS PROVIDED WITH MEANS FOR REMOTE CONTROL OF TRANSFER FROM AUTOMATIC TO MANUAL OPERATION

Control system embodies means to automatically regulate pressure at a point with manual means of regulation at a remote point and a means at the remote point to transfer control from automatic to manual. Patent 2,719,535 by George R. Anderson, assigned to Hagan Corp.

Data Processing

APPARATUS FOR LOCATING INFORMATION IN A MAGNETIC TAPE

A rotatable magnetic drum is moved in synchronism with a tape bearing message codes; parts of desired message are compared to the tape messages; and messages transferred from the tape to the drum when they coincide. Patent 2,721,990 by Joseph T. McNaney, assigned to General Dynamics Corp.

DOT PRINTING INTERPRETER

Record sensing means is combined with decoding means based on slides and cam arms to control a character forming wire printing means. Patent 2,720,164 by Karl J. Braun and Louis Cetrangelo, assigned to Remington Rand Inc.

• • •

Handling

EGG HANDLING AND PACKAGING MACHINE

Conveying means accumulates eggs in rows, spaces them uniformly, and aligns their major axes. The eggs are then upended, registered with cells of a carton, and dropped into the carton. Patent 2,717,729 by Clarence Page and George A. Page.

ARTICLE HANDLING AND ORIENTING MACHINE

Indiscriminately arranged cylindrical articles are fed from a hopper and arranged in a horizontal row with axes vertical and parallel by the action of an auger-like element and a belt conveyor. Patent 2,719,624 by Reed F. Fox and Carl N. Fox.

• • •

Machine Tools

MACHINE TOOL FOR AUTOMATIC CYCLING

Pattern-controlled slide is mounted on a second slide. Motor which positions alternate patterns is controlled by switches actuated by the second slide. Patent 2,720,129 by Max DeHaas and Claude E. Greene, assigned to the Monarch Machine Tool Co.

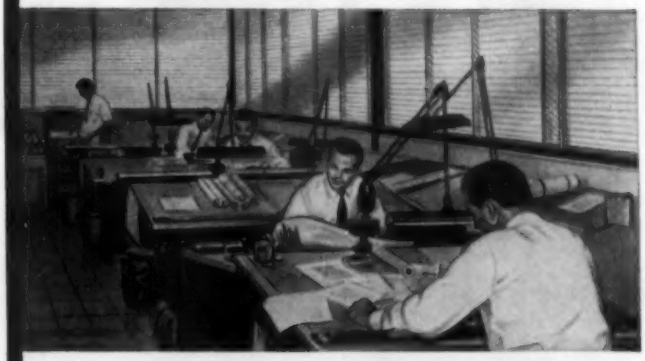
• • •

Process Design

PRODUCTION OF CONDUCTING LAYERS UPON ELECTRICAL RESISTORS

Imprinting of circuit elements on a plastic material is accomplished by covering the plastic with a slurry of conductive particles; applying heat and pressure to desired areas; and removing the particles from the parts of the surface to which heat and pressure were not applied. Patent 2,721,153 by Peter P. Hopf and Ronald E. J. Lishmund, assigned to Ward Blenkinsop & Co. Ltd., London, England.

FROM IDEA . . .



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82. Space Saving Conveyors

Homer Mfg. Co. Inc.—8-*page bulletin*—Completely automatic handling of ferrous parts and pieces is possible with magnetic conveyors described in bulletin. Units convey parts up inclines as steep as 90 degrees without need for belt cleats, stack parts, perform parts turnover and other handling operations. Diagrams and photographs illustrate conveyors in operation.

Circle No. 82 on Reply Card

83. Rubber Roll Handbook

Rodney Hunt Machine Co.—60-*page handbook*—How to specify, use and maintain rubber covered rolls are points covered in comprehensive, illustrated treatise. Characteristics of rubbers; thickness to use; types, shapes and balancing of rolls; and the care and feeding of rolls are among topics covered. Common troubles with rubber rolls and suggestions for treatment are listed in table form. Step-by-step description of the making of rubber rolls and discussion of factors affecting the nip action of squeeze rolls are also included.

Circle No. 83 on Reply Card

84. Processing Machines

National Automatic Tool Co. Inc.—20-*page booklet*—Combined operations to cut costs and increase production are indicated in photographs and discussion of drilling, boring, facing and tapping machines. Operation sequences are described in production of cylinder heads, cylinder blocks, crankshaft bearing cap sets, transfer gear housings, converter housings, transmission cases and stator frames. Station operations include checking, turning, indexing, rejection and replacement, chip removal, and sawing into separate parts.

Circle No. 84 on Reply Card

85. Special Cleaning Problems

Wheelabrator Corp.—34-*page handbook*—Application of specially designed airless blast equipment to 56 production cleaning problems, such as those met with cast, welded, forged, heat treated and machined components used in automotive, railroad, ordnance, and farm equipment and machinery is fully described. Case histories are taken from almost every major industry in the metalworking field. Descriptive drawings and photographs are also included.

Circle No. 85 on Reply Card

86. Airpainting Units

Paasche Airbrush Co., Div., Cline Electric Mfg. Co.—24-*page catalog*—Automatic application of coating and finishing materials to wide variety of products is possible with equipment illustrated and described. Straight-line conveyor automatic airpainting unit, cable conveyor type, automatic waxing unit, book edge coloring unit, coating and baking machine, and automatic air-lacquering unit are among models shown. Accessory equipment includes: automatic electric and foot operated *on* and *off* valves, conveyor *on* and *off* valves and oscillators, conveyor, horizontal and vertical oscillators, automatic airbrushes and atomizing assemblies.

Circle No. 86 on Reply Card

87. Mechanizing Paperwork

Teletype Corp.—8-*page bulletin*—Originating business records and paperwork as page or tape copy is covered in illustrated bulletin. Page printer, tape reproducer, keyboard tape perforator, tape render, and combination page printer, transmitter distributor and perforator transmitter keyboard—all designed for integrated data processing—are illustrated, and their operations and functions explained.

Circle No. 87 on Reply Card

88. Hose Couplings

Titeflex Inc.—20-*page booklet*—Quick connect-disconnect coupling design which affords speed and ease of handling is discussed and illustrated in cut-away drawings. Single-check and double-check valve modifications of coupling which seal off one or both ends of fluid line when coupling is disconnected are covered. Tables and diagrams indicate available coupling sizes and types of hose connections. Applications of coupling in different industries are also shown.

Circle No. 88 on Reply Card

89. Materials Handling

Lewis-Shepard Products Inc.—76-*page catalog*—Solutions to many types of materials handling problems are contained in collection of 25 illustrated pamphlets. Among industries covered in actual case studies are motor freight, chemical warehousing, food processing, paper, bottling, furniture, paint and rubber. Methods of cutting handling costs and gaining additional storage space are suggested for palletized and individually handled items.

Circle No. 89 on Reply Card

90. Electric Counters

Production Instrument Co.—8-*page bulletin*—High-speed counting with line of electrically operated counters having count life ratings from 3 million to 200 million are discussed and illustrated. Basemount, panelmount and dustproof models are covered, along with rotary, reciprocal, lineal measuring and heavy duty actuators. Specifications of counters and diagrams illustrating their installation are included.

Circle No. 90 on Reply Card

91. Plastic Wiring Ducts

Stahlin Brothers Fibre Works Inc.—8-*page bulletin*—Advantages of laminated plastic wiring duct, such as shorter wiring time, ease of wiring changes and simplified control panel layout, are illustrated. Specifications of four types of ducts, available in numerous sizes, are given.

Circle No. 91 on Reply Card

92. Rotary Stepping Switches

Automatic Electric Sales Corp.—34-*page catalog*—Complete description of rotary stepping switches and discussion of principles of electrical stepping control and operation are given in illustrated catalog. Two classes of switches—unidirectional motion and around-and-return motion—are covered. Numerous photographs and sketches illustrate mounting and assembly details. Specifications and features of various models are also included.

Circle No. 92 on Reply Card

93. Continuous Flow Instruments

M. W. Kellogg Co. — 16-*page booklet*—Automation in fluid processing is accomplished by control instruments. Components such as radio-isotope level measuring devices, data reduction systems, infrared stream analyzers, gamma ray instruments and magnetic susceptibility oxygen analyzers are illustrated and discussed. Diagrams are used to illustrate basic functions of control instruments.

Circle No. 93 on Reply Card

94. Photoelectric Controls

Autotron Co.—16-*page booklet*—Wide selection of practical application diagrams illustrate sensitive high speed and impulse actuated control units. Photoelectric controls are used in counting applications, and loop, door, size, bin level, and cut-off control operations. Units feature dual filament lamps, extra low voltage connections, light beam intensity adjustment for safety and protection. Illustrations of photoelectric controls, photoelectric timing controls and electronic timing controls are included.

Circle No. 94 on Reply Card

95. Heat In Hydraulic Circuits

Oilgear Co.—8-*page bulletin* — Generation and natural dissipation of heat in hydraulic circuits is the subject of illustrated bulletin. Information on heat transfer area, oil circulation rate, auxiliary pumps, power pumps, pipes and valves, complete with charted test results are included. Material should aid in engineering, installation and operation of fluid power in industry.

Circle No. 95 on Reply Card

96. Cable Conveyors

Tipp Mfg. Co.—8-*page bulletin*—Use of cable conveyors for processing, transporting, and temporary storage is discussed and illustrated. System components are clearly pictured. Eight steps in installation of cable conveyors are sketched and described, and suggestions are given on how to order or get an estimate on necessary equipment.

Circle No. 96 on Reply Card

97. Thermocouple Wires

Revere Corp. of America—12-*page bulletin*—Conductor specifications and recommended insulations for standard thermocouple wires at

HERE IS THE LATEST IN AUTOMATION "HOW TO"

various operating temperatures are given in bulletin. Properties and uses of thermocouple insulations, saturants and metallic braids are described. Reference tables included give junction emf ratings, resistance values, and lineal weights for thermocouples and lead wires.

Circle No. 97 on Reply Card

98. Low Maintenance Piping

Aluminum Co. of America—*18-page booklet*—Used for carrying fluids in chemical and petro-chemical plants, as well as in other processing operations, aluminum pipes feature corrosion resistance, product protection, excellent characteristics at low temperatures, smooth surfaces and thermal conductivity. Applications in pipelines, portable pipes and structural piping, along with similar applications of fittings, flanges and valves are illustrated pictorially. Tables and graphs provide dimensional and performance data.

Circle No. 98 on Reply Card

99. Automatic Thrust Control

Morris Machine Tool Co.—*12-page bulletin*—Rheostat-controlled electric clutch drive mechanism used on cam-driven drill units to provide automatic thrust control is described and illustrated. Drill units, designed for drilling, tapping and allied operations, feature rigid quill construction, automatic cycling, and antisurge protection. They can warn of dull or broken drills automatically. Components, specifications and dimensions of various models are given.

Circle No. 99 on Reply Card

100. Industrial Power Sawing

DoAll Co.—*108-page handbook* — Cut-off methods curently used throughout industry, and results of combination high-speed steel saw band and cut-off machine are main topics of tabbed catalog. Photographs and discussion on origin and development of saw and estimation of cut-off costs—with cost studies given are also included. Illustrations of actual installations and general sawing recommendations complete the comprehensive handbook.

Circle No. 100 on Reply Card

101. Centerless Grinders

Landis Tool Co.—*24-page catalog*—Ideas for automation with centerless grinders are illustrated with application photographs. Accessory equipment available with precision grinders includes automatic grinding wheel feed, air operated ejector, automatic diamond feed and bar grinding attachment. Components and features of machines are also discussed and illustrated.

Circle No. 101 on Reply Card

102. Variable Speed Units

Lewellen Mfg. Co.—*26-page catalog*—Power transmission and rotation are continuous, uniform and flexible in line of mechanical variable speed units. Controllers and regulators designed for use with transmissions are illustrated and described. Engineering data covering ratings, dimensions and information on transmissions, controls and accessories is given in chart form.

Circle No. 102 on Reply Card

103. Production Presses

E. W. Bliss Co.—*32-page catalog*—Production of inclinable presses is increased from two to ten times by use of automatic feeds, illustrated in catalog. Single- and double-roll feeds and dial feeds are discussed, and their specifications are given. Attachments, design features, and dimensions of inclinable presses from 10 to 200-ton capacity are also included.

Circle No. 103 on Reply Card

104. Centralized Lubrication

Farval Corp.—*20-page booklet*—Illustrations of lubrication systems used in various indus-

NEW CATALOGS

tries are included in booklet on automatic pumps, valves, spray valves and pumping stations. Lubricant measuring valves and their operation are shown in diagrams. Line of fittings which simplify planning and installation of centralized lubrication systems are also illustrated.

Circle No. 104 on Reply Card

105. Radio Interference

Stoddart Aircraft Radio Co. Inc.—37-page handbook—Measurement of radio interference with field intensity measuring equipment in accordance with Air Force and Navy Bureau of Aeronautics specification MIL-I-6181B is explained and illustrated. Specific instructions and practical examples are cited, including a perspective illustration of typical equipment setup. Appendix includes data on bandwidth concepts in interference measuring equipment.

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106. Power Operated Valves

Annin Co.—20-page booklet—Precise, positive control of hard-to-handle fluids in processing industries is provided by air-operated solenoid and pressure controlled valves. Among advantages explained are extra flow capacity, high pressure-temperature service range, and bubble tight shut-off. Operating characteristics, capacities and photographs of two types of valves, along with information on handwheel model, are included.

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107. Data Processing Device

Consolidated Engineering Corp. — 26-page catalog—Designed for multipoint data gathering and rapid, accurate data reduction, portable new magnetic tape system is multichannel and features rugged, sectionalized construction. Recorder, record amplifier, signal modulators, automatic calibrator, range time generator and playback equipment for system are illustrated and discussed.

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108. Computer Components

Servo Corp. of America—12-page bulletin—Basic computer and control components provide means for industrial control, problem solving, classroom demonstration and data processing. Among components covered are multiple signal generator, cathode ray indicator, demodulator, magnetic amplifiers of various types, unit for breadboarding electromechanical assemblies, and power supplies. Illustrations are provided by photographs and sketches.

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109. Speed Control System

Baldor Electric Co.—13-page booklet—Simplified system of speed control for operation from polyphase or single-phase alternating current circuits is described. System consists of motor-generator set with a small rectifier, controller and drive motor. Connection diagrams, schematic drawings, performance

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chart, specifications and illustration of system which provides 16 steps of speed adjustment are included.

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LITERATURE BRIEFS

110. Time Delay Relays

A'G'A Div., Elastic Stop Nut Corp. of America—4-page pamphlet—Correct unit for a desired delay or combination of delays in an electrical circuit may be chosen from a selection chart in this pamphlet. Types of operation, contacts, and contact arrangements are described and mountings and enclosures illustrated.

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111. Weight Totalizing

Richardson Scale Co.—2-page pamphlet—Analog-to-digital conversion in automatic weighing is described and illustrated with schematic drawings. Totalizing counter is operated by semicontinuous weigher with dial scale to provide automatic operation.

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112. Dial Feeders

A. K. Allen Co.—4-page pamphlet—Designed for vertical or horizontal mounting in areas where space is limited, indexing dial feed tables are completely equipped for fully automatic operation. Air controls regulate dwell time and forward motion without electrical components. Pamphlet contains photographs and scale drawing of feed tables.

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113. Photographic Recorder

Taller & Cooper Inc.—4-page pamphlet—New concept in classifying and recording of data is provided by automatic camera which not only photographs an event but simultaneously records on same frame any pertinent data desired. Photograph, specifications and applications of instrument are given.

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114. Precision Boring

Ex-Cell-O Corp.—4-page pamphlet—Production operations such as boring, contouring, turning, facing and grooving which can be done with cam-operated machines are discussed. Photographs and diagrams illustrate applications.

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115. Electropneumatic Control

Leeds & Northrup Co.—4-page pamphlet—Advantages of pneumatic control are combined with flexibility and fast response of an electrical system in new controllers described. Controller and associated converter designed for temperature applications in oil and chemical industry are illustrated and their specifications are given.

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116. Indicator Lights

Dialight Corp.—4-page pamphlet — Heavy duty industrial requirements are met by oil- and dust-tight omnidirectional lights discussed in pamphlet. Photographs, lamp drawings, dimensional diagrams and descriptions of accessories are included.

Circle No. 116 on Reply Card

117. Monorail Conductors

American MonoRail Co.—8-page bulletin—Insulated contact conductors provide safe crane and monorail electrification. Systems are available in capacities of 100 to 300 amp for use either indoors or outdoors. Bulletin includes illustrations and information on basic and spare parts.

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EAGLE
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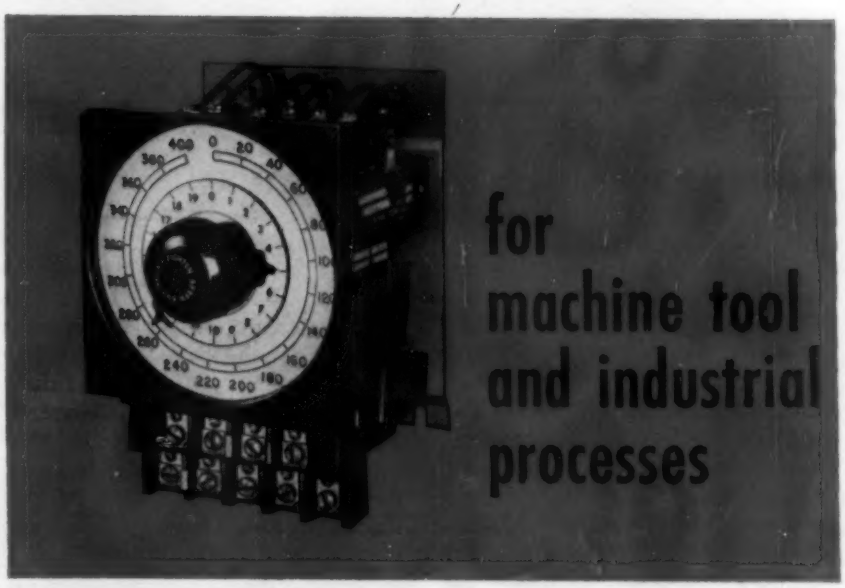

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AUTOMATION abstracts

MACHINE TOOL DESIGN FOR AUTOMATION

By K. O. TECH
The Cross Co.
Detroit, Mich.

AUTOMATION was not created overnight as a new technology with completely new thinking and ideas in design. It was rather the result of a continual development of mechanisms, hydraulics, and electric controls, and it is in the continued development of these details of design that our machine designers are doing the most to further the automatic factory of the future.

Success of our efforts in this direction will depend in a large measure upon our ability to control down-time. Automatic factories or automatic production lines, regardless of how beautiful they are on paper, cannot be tolerated unless they can be kept in production. Theoretically speaking, there is no limit to the number of operations which can be combined in one machine or process but when we consider efficiency, there is a limit. The practical limit is down-time. It is in the reducing of down-time and the increasing of efficiency to make possible automatic production lines that the future presents its greatest challenge to the machine designer.

Until tremendous numbers of operations were combined in machines, down-time was never very cumulative. That is, down-time on one operation had no effect on the production of another operation. Combining these operations in an automated machine means that every delay occurring at one part of the machine will shut down other parts of the machine. Thus we have a very high premium on dependability.

There are two basic classifications of down-time. The first is predictable down-time, such as time for changing tools, cleaning a machine, etc. We are making forward strides in automatic programming through the use of instrumentation to eliminate unnecessary down-time for these predictable causes.

Tool programming, for example, may be defined as the scheduling of tool operation from the time the tool is put to work in the machine until it is removed for resharpening. Most tool programming today is under operator control; i.e., the operator places the tool in the machine and keeps a mental account of its progress and removes it when he thinks it is dull. The need for automatic tool programming is quite apparent when we stop to think that tools which were once under close observation in single-station machines are now far removed from any immediate personal attention in transfer machines. Because of the inconsistency of tool performance and other variables, the first requirement of any programming device is flexibility.

The Cross Toolometer is such an

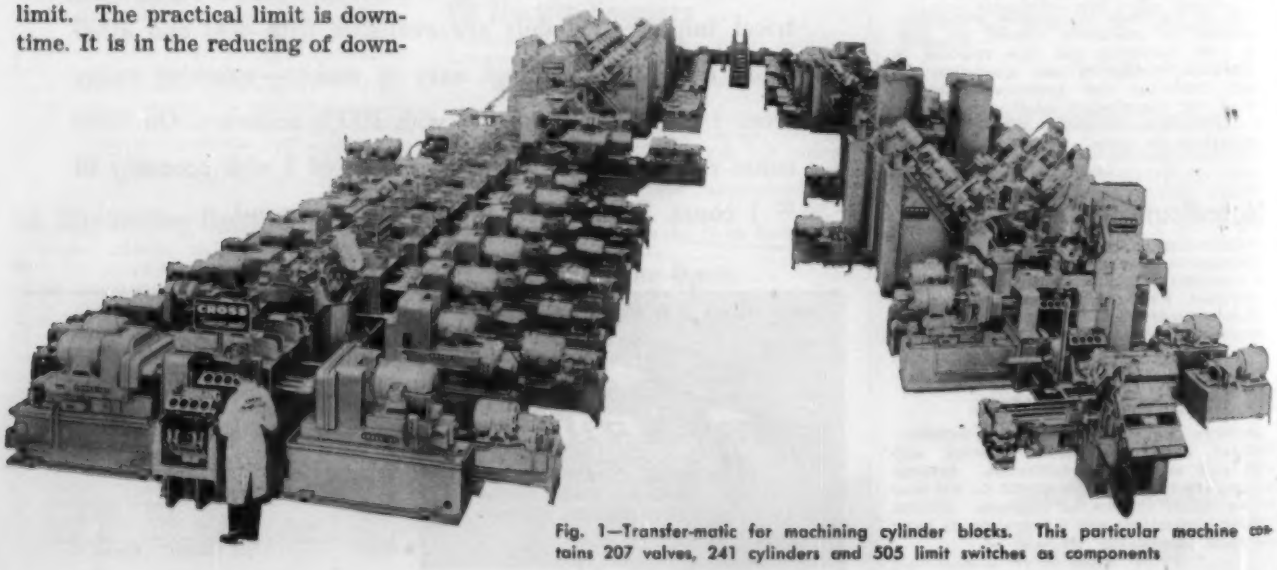

Fig. 1—Transfer-matic for machining cylinder blocks. This particular machine contains 207 valves, 241 cylinders and 505 limit switches as components

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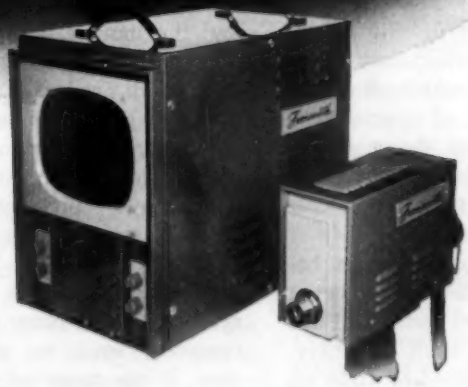

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individual tool-programming unit. It is a mechanical memory device that counts the number of operations a tool performs while it is working in the machine. After the tool completes its schedule of operations, the Toolometer shuts down the machine for a change. The Toolometer is flexible and may be changed instantaneously to a new program for any contingency.

Co-ordinating Design Elements

The second type of down-time, unpredictable down-time which generally results from breakdowns, is of great interest to the machine designer. This type of down-time can be practically eliminated for, in most cases, it results from poor design. To minimize this down-time, our machine designers are called upon not only continually to develop simpler, better operating, and more rugged mechanisms, but also continually to co-ordinate their efforts with those of the hydraulic and electrical designers in order to arrive at a completely integrated design. Our machine designers concern themselves with these other elements for the poor selection of hydraulic equipment or electrical equipment in relation to the job which must be done, poor location of special controls on and around the machine, or poor means for operating such controls can only result in excessive down-time.

This co-ordination is begun before the design is formally started so that all designers concerned are aware of the part each will play. We spend a good deal of time on many important problems of design in automation which are beyond the basic machine-tool design function of providing heads to drive our tools, slides or saddles to feed our tools, and fixtures to properly clamp our work while it is being machined.

Hydraulic Systems

From the hydraulic point of view, there are several important details that our designers must continually consider. The most important is leaks. Earlier this year, 150 men concerned with the design and use of hydraulics on automatic machine tools sat around in Detroit for two days discussing their mutual problems. The one problem which consumed the majority of the time was not the development of new and more complex valves; it was not even the improvement of the efficiency of present valves; it was merely how do we stop leaks on machine tools. Our machine designers work at stopping leaks by eliminating, wherever possible, threaded pipe fittings with the substitution of manifolds which can be O ring sealed.

Our machine designers concern themselves a good deal about valve mountings. Years ago the majority of our valves were located inside the machine where it was assumed they would be safe. They were reasonably safe, but they were also inaccessible and maintaining them was a big job. Our next step was to move the valves outside of the base, mounting them on the machine. Here we found they were much more accessible for maintenance, but they were also accessible to dirt and oil and the danger of operators stepping on them when they were not supported properly. As a result, we made another move. Wherever possible, we now mount our valves away from the machine, generally on hydraulic power units in small groups. They are out of harm's way and by keeping them in small groups, we have not increased our piping runs too extensively such as would be the case if we mounted them in one central location. A total of 207 valves are mounted in 71 locations on the Transfer-matic shown in *Fig.* 1.

Cylinders have offered us a more difficult problem. From a maintenance point of view, accessibility is extremely important. But cylinders must be attached to and operate some part of the machine. When a direct attachment to the mechanism to be moved results in very poor maintenance characteristics, we make a remote connection which gives us the desired accessibility. There are 241 cylinders used on the Transfer-matic shown in *Fig.* 1.

Electrical Controls

The location and mounting of electrical controls also interest our machine designers considerably. Limit switches are necessary on any machine where a number of co-ordinated movements must take place. The Transfer-matic illustrated carries 505 limit switches to insure its proper operation. It sometimes takes a good deal of ingenuity to place switches where they can do a job and, at the same time, be amply protected from the chips and other contaminants around the machine tool and be available for service. Plastic covers enable the maintenance man to check contacts without opening the switch.

Many times we tie together similar mechanical actions on a machine so that one limit switch can indicate completion of a group of mechanical movements. For example, 50 locating pins may be entered into 25 parts of a transfer machine. Usually it is better to interlock these pins mechanically, permitting the use of one power source and two limit switches. One switch indicates the entrance of the pins into their respective parts, and the other indicates their withdrawal. Without this mechanical connection at least 50 limit switches would be required to perform the same job.

Solenoids used to operate hydraulic valves are as great a source of maintenance as we have on our machines. Moving valves away from the machine has helped greatly in making this maintenance problem easier. However, when it is necessary to have a valve mounted close to the machine, we have made a practice of separating our solenoids from the valves they operate. Thus the solenoids can be maintained separately from the hydraulic valve or, conversely, the valve can be removed and replaced without requiring the services of an electrician to disconnect the solenoid. These solenoids are mounted in an

oil-tight compartment. In our present designs, the solenoid is mounted on the cover rather than within the compartment so that it is definitely necessary to have the cover in place before the solenoid can be operated.

Getting Back Into Production

Once a breakdown occurs on a machine, it is important that the machine be put back into production as soon as possible. One of the great aids we have found to insuring this is proper tagging and identification of units. All limit switches on a machine should be identified by number corresponding to the electrical diagram. All valves should be identified, not only by number, but as to a function of the valve. Compartments on a machine should be adequately tagged to indicate whether or not they are electrical raceways or contain mechanical components. All wires should be adequately identified so the tracing of circuits can be done easily.

The information necessary to maintain a machine properly and promptly does no good in the files of the plant engineering department. As much of it as possible should be on the machine where it is available to the men on the line who have to do the job.

Since the design of most of our automated equipment is a one-shot proposition, we emphasize in our designs the need for paying very close attention to minor details—details which can turn out to be not so minor when a breakdown occurs, holding up an entire processing line. All designers have a tendency to be very sure about the important problems in a design. We try to be just as sure about the little things. It is not too difficult to produce a Rube Goldberg type of design which may go through the motions at a questionable efficiency but the machine designer who watches his details is the man who will create the automatic factory that works.

From a paper entitled, "Machine Tool Automation" presented at the Annual Meeting of ASME in New York, Nov.-Dec. 1954.

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PRODUCT DESIGN MEETS PRODUCTION TECHNIQUES

By J. A. MILLER
Westinghouse Electric Corp.
East Pittsburgh, Pa.

HOW OFTEN have you been confronted with the problem of either having a sound engineering design that costs too much to manufacture profitably, or conversely, a new manufacturing technique that apparently does not have application to existing designs?

Certainly in this age of specialization of industrial personnel, these and many other problems involving the correlation of rapid advancements in both engineering principles and manufacturing techniques confront industrial management. Just as certainly, it is extremely difficult, if not impossible, to have within either of these two separate phases of an organization sufficiently experienced or trained personnel to correlate advancements.

Through the introduction of a third member to the organization, the Transportation and Generator Div. of Westinghouse Electric Corp. has found a means of bridging this gap. This third member of the organization has been called "manufacturing engineering." Its introduction has produced some outstanding results, and its role in the future planning of the division is becoming of increasingly greater importance.

Functions and Responsibilities

Basically, the manufacturing engineering organization is a staff function with direct responsibility to the manager of the manufacturing organization. As such, it is the responsibility of this group to assist him in the control of manufacturing costs and instigate whatever action is deemed advisable in the development of new methods, processes, or equipment to achieve this end. In addition, it is their responsibility to review and make recommendations on engineering designs that might lead to improvement from a manufacturing standpoint.

One of the paramount problems when products are generally not standardized is in the development of new processes, tools, equipment, etc., with a minimum of lost production time. In general, the product repetition is limited to such an extent, and the apparatus is of such a physical size, that production and development must proceed hand in hand. One solution to this problem lies in the use of a manufacturing laboratory. The laboratory provides a means to overcome the problem of lost production time due to development and expedites development completion. It also provides a means of establishing the process completely, the sequence of operations, a time-study breakdown, and a place to systematically train operators. Development work, conducted by personnel genuinely interested in its successful completion, free from production-schedule pressure and systematically conducted, is a most desirable goal.

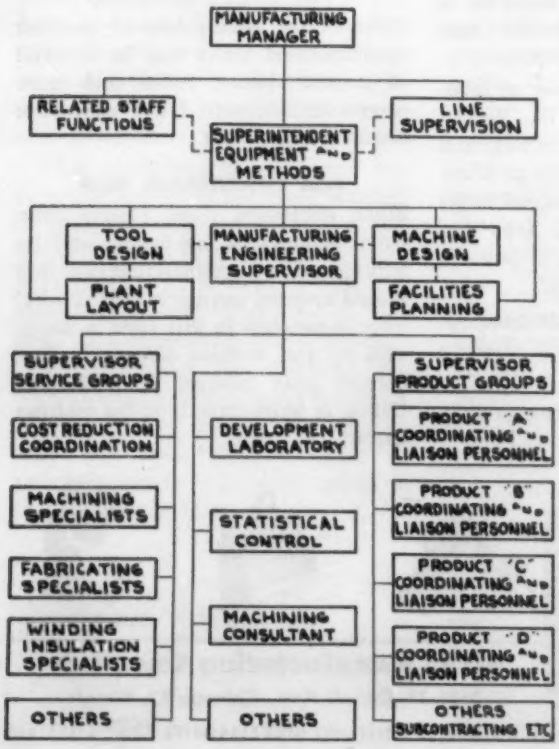

Fig. 1—Organization chart for manufacturing engineering department. The correlation of the size of a manufacturing engineering department to other phases of the business is a very important one. Personnel assignments in relationship to types and volume of products being manufactured must also be considered

The necessity for constant surveillance of manufacturing processes and sequences makes the manufacturing engineer a vital member in plans for the purchase of new equipment and the rearrangement of existing equipment. He is often called upon to establish the manufacturing facilities, floor area, and manpower requirements to produce new products or existing designs requiring a change. Changes in volume of business also often require the expansion or contraction of facilities to meet desired schedules or to minimize transportation and material-handling problems.

Close co-ordination with the design engineering department is a major responsibility of this department. Regularly scheduled visits to the engineering drawing department are made to review completed tracings with the engineering representatives. This review is made with the intent of noting and correcting problems which might occur. Frequent consultations are made at the time the tracings are on the drawing board. Such problems as finish requirements, welding requirements, tooling required, types of materials, suitability for efficient machining techniques, ease of assembly, and tolerance requirements are reviewed. A system requiring that all tracings receive a manufacturing engineer's initialed approval has been established, thus insuring that a thorough review is made of each new design. This approval

must occur before the tracings can be released for manufacture.

In addition to the system of reviewing drawings, regular committees have been established within the engineering department and a manufacturing engineer is a regular member of each of these committees. Semimonthly meetings are held to review cost data on lines of apparatus. Those items requiring attention are scrutinized from a design standpoint with the intent of introducing design changes which will not only improve manufacturing costs but performance as well. Major reductions in cost have been achieved in this manner and such reviews have led to radical departures in design practices resulting in major design improvements.

Organization Structure

As in the case of any staff department, it is essential that the personnel within the manufacturing engineering department be so organized that their functions tie in directly with the other departments involved.

Engineering departments generally are organized by lines of apparatus or machines. The shop manufacturing sections, on the other hand, with the exception of assembly sections, generally are grouped by similarity of processes. Normally, this would mean that such operations as fabricating (burning, welding, shearing, etc.), machining, and other preassembly operations would be grouped together without too much regard for type of apparatus, with size being the main criterion for segregation. Other staff organizations then, generally, are patterned so that their structure is basically the same as one or the other of the foregoing organizations.

This condition, in the case of the manufacturing engineering departments, which must function equally well in conjunction with both the engineering and manufacturing sections, creates a problem in organizational structure. Experience gained within the Transportation and Generator Division, which has a multiplicity of products and a wide range of manufacturing processes, indicates that a single organization of manufacturing engineering is desirable.

Basically, this organization is composed of two parts, under the guidance of separate supervisors, but co-ordinated within a single department by a departmental supervisor. One part of the organization consists of personnel who are grouped by lines of apparatus or products. These apparatus or product groups are directed by a group leader and have a responsibility for the overall co-ordination of costs of a particular type of apparatus. The other part of the organization consists of personnel who are organized by manufacturing processes. These process or "service groups" act as consultants to the "apparatus groups" and, in addition, spend considerable time on the development of manufacturing processes in the combined apparatus-manufacturing sections.

This organizational structure provides both overall product co-

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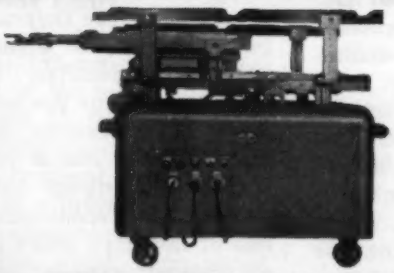

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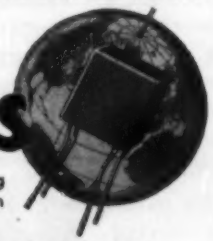

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ordination and, at the same time, provides a workable solution to the problem of manufacturing process development with a minimum of overlapping of responsibilities and efforts. Maximum use is made of the talents of the entire group so that machining, fabricating, and other process experience is provided for all lines of apparatus, and projects which entail development common to more than one line of apparatus are easily coordinated.

Personnel Requirements

Basically, this manufacturing engineering department, *Fig.* 1 is composed of a combination of technically trained personnel working in conjunction with functionally experienced personnel. This, in view of the present general national shortage of graduate engineers, is, of course, of extreme importance. Present experience within the department seems to indicate, in addition, that this combination of personnel also results in a better working balance within the group. Shortcomings in practical experience within the manufacturing sections, on the part of the graduate engineers, are thus balanced by the experience of the functionally trained personnel, and, conversely, technical knowledge and methods of analysis, lacking in the functionally trained personnel, are balanced by the engineering background of the others. This is important in order for such a department to function properly between both the manufacturing and engineering sections of the organization.

By nature of the manufacturing engineering department's functions, it is essential that, in addition to having a good technical or functional background, the personnel within the department have certain other personal attributes. In order to function properly with the many personnel of the other departments with whom contacts are made, the ability to express thoughts clearly, create good impressions, and think clearly, become of prime importance. The manufacturing engineer, in a sense then, becomes a combination of technician, salesman, politician, and analyst. Experience thus far gained indicates that a system of pretesting personnel before their addition to the group can do a great deal toward satisfying the stated condition. Correlation of these test results with job performance has proved this rather conclusively.

Training Ground

It should be noted that the department serves the division as a valuable training ground for future management positions. Its wide coverage of work and the contacts that, of necessity, are made are valuable experience for potential supervisory personnel. Because of the high personal characteristics required of its personnel and the chance for observation of the performance of these individuals, many opportunities for advancement have been opened to personnel within the department. These personnel obtain a broader view of the division's operations than would be possible in almost any other line of endeavor.

The manufacturing engineering department is organized to serve as a control on manufacturing costs, product quality, and delivery completion. It has, from a standpoint of facilities, funds, and experience, the ability to review problems arising in either manufacturing or engineering, and through co-ordination of thinking and efforts on the part of both, expeditiously resolve the problems. Because of the nature of its work and freedom of movement, it is able to initiate or assist in the development and application of improved methods, processes, tooling, equipment, and work-area facilities.

It has, through the resultant cost savings attained, proved that such a department can be a valuable asset to the operation of the division.

From a paper entitled, "Manufacturing Engineering — A Key to Increased Production and Lower Costs" presented at the Semiannual meeting of ASME in Boston, June 1955.

INDUSTRIAL INSTRUMENTS AND ECONOMIC FACTS

By RAYMOND E. OLSON
Taylor Instrument Companies
Rochester, N. Y.

THE AMERICAN system of free enterprise is great because, among other things, it reinvests a large percentage of its profits in the tools of production. The use of tools has increased enormously over the past century, yet tools have never been a threat to men. They have been man's benefactor as demonstrated by high employment figures and a high standard of living. Automation is the extension of the use of tools, marvelous in their complexity and productiveness. The instrument industry is the forefront of this next great advance for which there is every social and economic justification. This is the basis for my optimism and I hope to make it yours also.

Savings with Instrumentation

Many processes today would not be operable without automatic control—the use of instrumentation is taken for granted irrespective of labor availability. It is deplorable, however, that very little data is being circulated on actual savings derived from the thousands of different instrument applications in use in all industries. Much publicity is given to the technical aspects of instrument design and performance. This is quite proper, but the underlying driving force in terms of economic gain—the side of the story which in the final analysis management must consider, remains untold far too often. Progress even greater than has been made in the past would most assuredly accrue to the benefit of all if there could be a free interchange of the economic facts of process instrumentation.

An example affecting the welfare of every individual in our country is the milk industry. I am referring to the process of pasteurization which for many years was carried out on a batch basis, and as a matter of fact still is for low volume plants. Accurate con-

trol of temperature in relation to time is vital for safety. The competitive pressure for cost reduction and product improvement stimulated the use of more and more instrumentation on each vat. The investment in instrumentation rose from $25 to $400 for each vat. A plant producing 8000 quarts of pasteurized milk each day spent at least $2500 for instrumentation. But as demand increased with population growth, the batch system had to be abandoned as inadequate, particularly in plants serving large urban areas. Today a continuous system is in common use in thousands of pasteurization plants. This evolution in pasteurizing methods has had much to do with making milk one of our best food values today. And such would not be possible without process instrumentation. In this case, the investment in instrumentation has been materially reduced considering the greatly increased output from a given installation.

One could cite many comparable examples, embracing all industries, of the contributions of process instrumentation to our economy. The more such information is disseminated the greater can be our rate of progress in further raising our living standards.

Industry-Wide Effort

Industrial process instrumentation is one of the most vital production tools at the disposal of American industry. Starting from a single instrument applied to a vital point in a process it has matured into comprehensive control systems upon which complicated processes depend for automatic direction. True, instrument manufacturers by their own enterprise have made possible the availability of constantly improved devices. But in reaching its present position the process industries can claim their well deserved credit. Their never ending insistence on instruments of greater reliability and usefulness and devices to measure and control new process variables has been stimulating. Furthermore, it is the user who by sympathetic understanding, cooperation and the willingness to share in a calculated risk, has provided a real incentive for instrument manufacturers to strive to continue to offer products of improved performance.

To reach these higher levels of production represents a challenge. In our free competitive economic system, the urge which in the past has pushed us along the road to greater reliance upon more and more comprehensive automatic control systems, still persists. So-called environmental forms of control systems undoubtedly will continue to be a basic production tool. The employment of analytical type instruments and computers will be put through the mill of experience. Devices not yet conceived or now in embryonic form are sure to mature. Exciting chapters of accomplishment are yet to be written. It can be predicted with certainty that the industrial instrument industry will continually strive to make its contribution to the solution of the problems which lie ahead — working in cooperation with the designers and operators of the processes of the future.

Peter F. Drucker, Professor of Management at the New York University Graduate School of Business, has said, "I believe that automation will not inundate us in a sudden flood, but will seep in gradually though steadily. There can be little doubt that the first country to understand and apply automation systematically will lead in productivity and wealth during the second half of the twentieth century, just as the United States through understanding and applying mass production led the world during the earlier half century."

The seeping process has long since begun. The instrument industry understands and is applying automation systematically. The instrument industry is already making sure that the United States will lead in productivity and wealth during the second half of the twentieth century.

From a talk entitled, "Industrial Instrumentation in Our Economy," presented at the Tenth Annual Symposium on Instrumentation for the Process Industries at Texas A and M, College Station, Texas, Jan. 1955.

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THE AUTHOR

C. W. Worley is a control consultant in the application engineering division at Brown Instruments Div. Minneapolis-Honeywell Regulator Co. Here he has been concerned with the application of the feedback control techniques to process control.

An electrical engineering graduate of Ohio State University, Mr. Worley's contributions to technical advancement include papers presented to electrical, chemical and instrument engineering societies and speeches at local society meetings.

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HYDRAULIC AND PNEUMATIC POWER FOR PRODUCTION

By Harry L. Stewart; 406 pages, 6 by 9 inches, illustrated, clothbound, published by the Industrial Press, New York; available from AUTOMATION*; $8.50 postpaid.*

How to choose equipment, circuit arrangement and operating medium for individual applications of hydraulic and pneumatic power is explained in this reference book for designers, installers and operators. Design, installation and operating recommendations are given and circuits and details illustrated. Tables of standard J.I.C. graphical symbols are also included.

HANDBOOK OF ENGINEERING MATERIALS

Edited by Douglas F. Miner and John B. Seastone; 1380 pages, 5½ by 8½ inches, illustrated, clothbound, published by John Wiley & Sons Inc., New York; available from AUTOMATION; *$17.50 postpaid.*

This new handbook is meant to be a single source of information on the usual materials of manufacturing and construction. It is not all-inclusive but is a useful guide to selection of a wide range of materials and suggests sources of more information. Its scope is more complete than a technical dictionary but less detailed than specialized handbooks, and historical background and methods of manufacture have generally been omitted. This handbook is divided into four main sections—general information on materials, metals, nonmetals, and construction materials. Subsections include: Materials specifications and standards, statistics in application of materials, mathematical and physical tables, etc.

Association Publications

THE AUTOMATIC FACTORY — WHAT DOES IT MEAN?

Clothbound, 228 pages, 8½ by 11 inches, illustrated; available from the Institution of Production Engineers, 10 Chesterfield St., London W.I., England; $3.50.

This is a report of a conference held at Margate, England in June, 1955, to consider various aspects of automation. Good papers are presented covering a range of material from historical background to detailed examples of feeding devices. Managerial, educational and social considerations are discussed, as well as examples of automation in offices, metalworking, chemical and petroleum plants. The volume includes complete texts of papers, discussion comments, and descriptions of exhibits.

CONTROLS AND TECHNIQUES FOR BETTER MANAGEMENT

Paperbound, 64 pages, 6 by 9 inches; available from American Management Association, 330 West 42nd St., New York 36, N. Y.; $1.75.

Booklet contains papers presented at the AMA General Management Conference in Los Angeles early last year. Professor Peter F. Drucker discusses operations research in nontechnical terms and what managers can expect from the new tools. J. E. Jonsson of Texas Instruments Inc. describes administrative controls used for growth of his company. Hugh F. Colvin of Consolidated Engineering Corp. reports on controls for research and development in his company. Pitfalls of collective bargaining, training for cost reduction, and worth of personnel testing are discussed in other papers which are included.

Industrial Publications

OFFICE AUTOMATION

Loose-leaf, 283 pages, 8½ by 11 inches, illustrated; available from Automation Consultants Inc., 1450 Broadway, New York 18, N. Y.; $12.50.

Definitions, history and sources of information are given regarding office automation. Available items of equipment are illustrated and specifications and prices indicated. Service to maintain up-to-date status of volume is also being offered on annual basis.

THE FABRICATOR'S HANDBOOK

Loose-leaf, 162 pages, 5¾ by 8½ inches, illustrated; available from Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 30, Pa.; by request on company letterhead.

Reference book describes how to fabricate stainless steels. Forming, machining, cutting, joining, heat treating, pickling and finishing are covered. Tables include data on properties, compositions and uses as well as general conversions. Spot testing methods are outlined for identifying stainless types.